Students' Attitudes Towards Web Search Engines – Increasing Appreciation of Sophisticated Search Strategies

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Web search engines have developed into widely used services and essential tools for finding Web-based information. Research has found that although users typically follow 'unsophisticated' information-seeking patterns, they appear to be satisfied with the performance of search engines and themselves as information seekers. This paper argues that the development of information literacy skills in the context of Web search engines requires deeper understanding of the reasons underlying already established behavioural patterns. The study explored the information-seeking behaviour of sixty-six postgraduate students and examined user satisfaction through the perceptions of students about themselves as information seekers. It was found that the students were experienced Web searchers but they shared less appreciation for the value of more complex strategies in the Web environment. Although they were aware of the limitations of their information-seeking behaviour they had minimal motivation to change habitual behavioural patterns. The paper concludes that there is a need to place less emphasis on developing 'optimal' search skills through information literacy instruction and focus on increasing motivation and appreciation of more complex search strategies.

Introduction

Web search engines have developed into widely used services and essential tools for finding Web-based information. Not only have the number of Web users who employ search engines for Web information seeking increased (Morrissey 2003; Fallows 2005) but also the use of Web search has been found to predominate over all other types of Electronic Information Seeking (Griffiths & Brothy 2002). As a result, studies that investigate user information-seeking behaviour when using Web search engines have proliferated, more robust search engines tailored to users' particular needs have been developed and new directions for provision of user training geared towards supporting effective Web information retrieval strategies have been sought. The growing popularity of search engines and users' increasing responsibility in answering their own information needs have highlighted a change in our perceptions of information literacy in the traditional library-based approach and a movement towards new definitions that acknowledge the importance of incorporating instruction on Web-based information searching skills (Association of College and Research Libraries 2007).

Although there is a greater emphasis on Web search engines as important tools for information retrieval, quantitative analyses of large sets of data collected from real online searches reveal that search engines are not used to their full potential, and online searching behaviour of users has retained for the past years a rather homogeneous character with Web users following surface strategies, appearing reluctant to build complex searches, investing little effort in structuring a search and viewing only a small number of results (Jansen & Pooch 2000; Silverstein et al. 1999; Lucas & Topi 2002; White et al. 2002; Spink & Jansen 2004; Jansen & Spink 2005). The same applies largely to stud-

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ies of student search behaviour. Although students can theoretically discuss the critical role of information literacy skills (e.g. evaluation criteria) they are not effective in practically linking knowledge to application (Becker 2003) and are not successful in applying sophisticated search strategies when conducting research on the Web (Tompson 2003).

Paradoxically, despite the evidence pointing to lack of sophisticated search strategies and critical appraisal of information when using search engines, Web users, on the whole, appear to be satisfied with the performance of Web search engines as information retrieval tools (Sullivan 2000; Fallows 2005) and rate the quality of their own Web search skills highly (Becker 2003; Thompson 2003; Buschman & Warner 2005). Yet little is known about the underlying reasons that lead to that contradictory evidence. In the context of that it is no longer effective to provide information literacy instruction without considering the impact of Web search engines on information-seeking tactics and strategies and the ways in which users perceive themselves as information seekers. As long as users of Web search engines are content with their search results and believe they are confident and capable search engine users, "the need to refine search terms, or use alternative sources may not emerge" (Ray & Day 1998). This paper, therefore, argues that successful instruction of information literacy skills in the Web environment requires deeper understanding of users' perceived effectiveness of their own information-seeking strategies, as well as their particular expectations related to the search engines they use.

Purpose and scope of the study

This research is part of a larger PhD study, which examined postgraduate students' information-seeking behaviour when using Web search engines. The study identified and analysed the physical, cognitive, affective, and social characteristics, which need to be understood to provide an holistic overview of the information seeking process in the context of Web search engines (Martzoukou 2006). Drawing on some of the findings of the PhD study, this paper addresses the need to understand the role and significance of information literacy in the context of search engines. It is argued that a more comprehensive analysis of users' definition of 'satisfaction' is required in order to understand

the potential impact of information skills education in the Web environment. Particularly, the research examines the behavioural characteristics of the selected user group and also analyses their satisfaction with information searching results when using Web search engines. The results presented here are not based on a 'traditional' attempt to verify the success or otherwise of Web search engines as information retrieval tools. Rather, the research focuses on examining and understanding user satisfaction and performance through the perceptions of students about themselves as information seekers.

Review of relevant literature and rationale

Commercial search engines, such as Google, have often been dismissed as information retrieval tools that give access to "infobesity" (Bell 2004), "a junk information diet" (Brophy & Bawden 2005, 499) that leads to a "more is better" approach (Joint 2005, 401). However, recent studies indicate that widely used search engines, such as Google, could play a more important role in the information-seeking process. For example, Brophy and Bawden (2005) after comparing an Internet search engine (Google) with academic library resources in order to assess the relevant value, strengths and weaknesses of the systems found that good coverage requires the use of both systems as both have unique features. The authors concluded that both systems had advantages and disadvantages but Google managed to retrieve a high proportion of relevant documents, adequate or good quality results and unique documents and there were no problems with accessibility.

There has been a lot of commentary on the disadvantages and downside of easy information retrieval (Joint 2005) and the challenges that this presents for the future role of library and information professionals in general (Kesselman & Watstein 2005), often alluding to a clear competition taking place between 'unregulated' information resources (McDowell 2002), such as Internet search engines and library services (Massey-Burzio 2002; Carlson 2003). This emanates from the fear that autonomous searching will make many library services redundant, a rationale which offers little opportunity for acknowledging the value of Web information retrieval tools and addressing the ways in which they could be positively exploited for the

benefit of end-users. This has had a great impact on library and information training and information literacy programmes aimed at university students. Most instruction on online searching focuses on the use of bibliographic databases without attempting to address ways in which users' ability to search for widely available Web-based information could be improved; although recent research suggests that efforts to address the problem of superficial and inefficient search strategies on the Web may be underway (Ghapery 2004; Kesselman & Watsein 2005). With non-mediated information searching and ease of access to information of variable quality, increasingly more Web search engines users develop "unintelligent patterns of information retrieval and use" which "can be seen as the result of offering users powerful search tools without appropriate guidance on the information literate use of such tools" (Joint 2005).

As a consequence of this, users rely on trial-and-error approaches to learning, accidental information encounters and easy-to-get information. Research reports that Web users are not comfortable with the use of Boolean operators (Jansen & Pooch 2000), that they prefer to form unstructured queries (Silverstein *et al.* 1999) and that they have poor query formulation skills (Lucas & Topi 2002). Search engine users seldom modify their initial search terms and formulate queries, which are "typically short, ambiguous, and are often only an approximation to the searcher's real information need" (White *et al.* 2002). Overall, as reported by Spink and Jansen in their review of large studies of Web searching behaviour, between 1997 and 2003, queries are short without modifications, advanced searching is uncommon and when it occurs it includes mistakes. In addition, users view a few results pages and only about five Web documents (Spink & Jansen 2004). Although the above studies were conducted mainly with American Web search engines users, parallel research with an European focus concludes to similar research findings; in Web search there is a general decline in query length, with the use of extremely simple queries and the majority of Web searchers view fewer than five Web documents (Jansen & Spink 2005).

At the same time a similar picture has started emerging from new research that examines the information seeking behaviour of university and college students. Although this group overall is more information literate, there is a gap in their ability to apply this technology cognitively in meaningful ways (Educational Testing Service 2006). This gap in information literacy skills is evident in their over-reliance on search engines and in the development of over simplistic information-seeking behaviour. For example Stace, Stacey and Chapman (2003) in a study using remote observation of students' information seeking, found that students relied on simple search strategies, characterised by negligible use of Boolean operators and misspelled search terms. Graham and Metaxas (2003) make references to a naive belief prevailing among young search engine users that all needed information can be easily found using Web search engines; this misconception often leads Web search engine users to regard their first search result as an authoritative and definitive source of information.

Overall, according to Brown, Murphy and Nanny (2003, 386) it is questionable whether Internet users in general "are able to effectively filter through the large quantities found to successfully recognise misleading, flawed, or incorrect information." Evidently, what is lacking from the modern information-literate student is not information technology skills but solid information skills, which are an essential part of information literacy. Notably, not only the ability or willingness to construct sophisticated strategies for locating information using the Web but also the "awareness and understanding of the way in which information is produced in the modern world, [and] critical appraisal of the content and validity of the information (linking with elements of critical thinking more generally)" (Society of College, National and University Libraries 1999). Brown, Murphy and Nanny (2003) have expressed this as a need to bridge the gap between "techno-savvy" and "info-savvy" and build information literacy instruction on the basis of activities that are of relevance to the lives, needs, learning styles and information requirements of Internet users.

The above could explain why a number of Web search engine users surveys have concluded that more that 80% of searchers have successful search experiences most of the time (Sullivan 2000; Fallows 2005):

> ... most users quickly feel comfortable with the act of searching. Users paint a very rosy picture of their online search experiences. They feel in control as searchers; nearly all express confidence in their searching skills. They are

happy with the results they find; again, nearly all report that they are usually successful in finding what they're looking for. And searchers are very trusting of search engines, the vast majority declaring that search engines are a fair and unbiased source of information. (Fallows 2005, i)

This, according to Joint (2005, 398), emanates from a state of "satisfied ineptitude" of the average search engine user who is "pleased at the ease of the retrieval facilitated by these tools but who remains content with the most easily retrieved data rather than the best possible information". As Brophy and Bawden (2005, 499) explain it is therefore "of course, inevitable that convenient access to information which, while it may not be comprehensive or of the highest quality, is good enough, will be alluring." Thus in the context of Web information seeking, a significant ingredient of information literacy should address not simply the development of optimal skills but also the ability to make intelligent choices that will go beyond easy and convenient access to information and will increase understanding of the benefits and value of using more sophisticated search strategies.

Research design

This research study used multiple methods for data collection to provide a rich set of qualitative and quantitative data, informing students' information searching behaviour and attitudes. Employing multiple techniques of investigation, allowed "analysis to be carried out of any gap which may exist between the expectations of service and the reality of that service as seen through users' eyes" (Banwell & Gannon-Leary 2000, 191) and helped to increase theoretical understanding of the studied phenomena.

For the collection of qualitative data, methods of naturalistic inquiry were employed, which according to Mellon (1990, 20), "should be selected where in-depth understanding of human actions is the primary focus." Thus the participants were studied in a natural setting and there was no attempt "to completely control the condition of the study" (Patton 1991, 42).

The main method consisted of an empirical investigation of information-seeking behaviour of sixty-six post-graduate students, the majority of whom were enrolled in Information Management related courses and were experienced users of Web search engines. In order to be closer to a real-life situation of information seeking, the students were observed during searching for information on a topic of personal interest using Web search engines of their preference and no limitations were imposed to satisfy the purposes of a controlled experiment. The searching session ended when the participants felt that they had either collected the needed information or searched enough on the particular topic. Behavioural data were collected in an unobtrusive manner using *CamTasia Studio*, a software application which captures real-time interactions and provides the flexibility of playing back videos of captured screen activity. This allowed obtaining direct user feedback, which helped to explain information searching behaviour from the viewpoint of users immediately after the completion of the search activity. The overall purpose of the information-seeking task was to provide a basis for discussion with the students rather than draw general conclusions from analysing single search episodes in a quantitative way (e.g. number of search terms, reformulations, number of pages viewed).

Except for behavioural data capturing information needs of users was also important. Information seeking has been described as "the purposive seeking for information as a consequence of a need to satisfy some goal" (Wilson 2000, 49) and this perceived need for information leads someone to use an information retrieval system in the first place (Schneiderman *et al.* 1997). The goal directed acquisition of information (Choo, Detlor & Turnbull 2000; Wilson 2000) is connected to personal, work or socially-related objectives. Therefore, prior to conducting the search, the participants were asked to describe their particular information needs and the reasons for conducting the search (see Appendix 1). Hence instead of acquiring an experiment-like character, where participants are recruited to perform a search without a task-related need, the study adopted the character of observing users with "real information needs related to tasks at hand rather than hypothetical questions based on topical interests" (Wang 1999, 67).

Observation was complemented with an informal, semi-structured and open-ended interview with each one of the participants (see Appendix 3). Its purpose was to examine reasons behind specific patterns of behaviour, expand on problems encountered during the search, compare observed behaviour (as manifested in the search task) with

typical behavioural patterns followed across different searches and investigate perceptions related to using search engines in general.

Quantitative data were also captured related to participants' demographic characteristics (age, gender, academic background) and their perceptions about the overall quality of search engines as information retrieval tools from the Web (using a Likert five-point scale, ranging from 'very poor' to 'very good'). Post-search satisfaction levels related to the degree of user overall satisfaction with the specific information seeking task performed by the students were also collected after the completion of the search (using a Likert five-point scale, ranging from "not at all" to "a lot") (see Appendix 2). The degree of user overall satisfaction with the outcome of the task was measured in respect to two levels of performance:

a) the performance of the search engine(s) used according to the users' perceived effectiveness of results

b) the performance of the users as information searchers, judged from the viewpoint of the users

The decision to use user satisfaction as basis for system effectiveness was based on Su's (1998, 558) users' judgement of overall system success, which suggests that the value of search results as a whole is the best single measure of interactive information performance. However, an additional measure was introduced because satisfaction also incorporates users' perceptions of the effectiveness of their own information retrieval skills.

Qualitative data obtained from the interviews were transcribed and encoded. An inductive approach to the analysis of the qualitative data was adopted, employing QSR's NVivo software. All interviews were transcribed and coded into meaningful categories. Information segments were compared to each other across participants and categories until theoretical saturation was reached, when no new code categories could be produced by the data, as described by Glaser and Strauss (1967).

Results

Demographic characteristics

All the participants were postgraduate students (PgDip [Postgraduate Diploma], PhD), studying in a variety of courses in the Business School at

Table 1: Distribution of Students in Courses

Course	No	%
Information and Library Studies	33	50.0
Knowledge Management	2	3.0
Electronic Information Management	12	18.2
Information Analysis	2	3.0
MBA	5	7.6
PhD	9	13.6
Publishing	1	1.5
International Information Technology Law	2	3.0
Total	66	100.0

The Robert Gordon University in Aberdeen, Scotland (see Table 1). Although the distribution of students in the listed courses was not equally representative of all subject disciplines (i.e. there was a high proportion of Information and Library Studies and Electronic Information Management students), this was linked to the voluntary nature of the study and its holistic design, which involved spending a considerable amount of time in order to complete all the different stages of the process (pre-search questionnaires, performance of Web information seeking task, post-search questionnaire and interviews).

Further characteristics of the sample are given in Table 2. The sample consisted of a mixed group that included: a) students who had enrolled in a postgraduate study directly after the completion of their undergraduate degrees (the 21–24 age group); students who had acquired working experience or taken some time off before embarking on an undergraduate study or before the beginning of their postgraduate studies (the 25–28 age group); and 'mature' students who had returned to education after acquiring considerable professional working experience (the age 29 or older group).

The sample also included a high percentage (66.7%) of female participants. This was explained as the outcome caused by a general "numerical domination of the library and information workforce by women" (Goulding and Cleeve 1997). In addition, out of the total number of subjects, 69.7% were native English language speakers, while the rest (30.3%) spoke English as a second language.

Finally, the majority of participants (71.2%), had been using Web search engines for a period of more than two years (n=47). 19.7% of the students (n=13) had one to two years of experience, while

Table 2: Summary of Descriptive Statistics of Demographic Characteristics

Age

Age	Frequency	Percent
21–24	19	28.8
25–28	19	28.8
29 or over	28	42.4
Total	66	100.0

Gender

Gender	Frequency	Percent
Female	44	66.7
Male	22	33.3
Total	66	100.0

Language

Language	Frequency	Percent
English	46	69.7
Other	20	30.3
Total	66	100.0

Table 3: Summary of Descriptive Statistics of Experience in using Web search engines

Experience	Frequency	Percent
0–1 year	6	9.1
1–2 years	13	19.7
2 years or more	47	71.2
Total	66	100.0

Table 4: Perceived Quality of Search Engines

Quality	Frequency	Percent
Very poor	1	1.5
Poor	0	0
Moderate	17	25.8
Good	38	57.6
Very Good	10	15.2
Total	66	100.0

Table 5: Search Services Used

Sources	Frequency (n=84)	Percent %
Google	55	83.3
Yahoo	15	22.7
AltaVista	9	13.6
Lycos	5	7.6
MSN Search	4	6.1
HotBot	1	1.5
AskJeeves	2	3.0
Infoseek	1	1.5
Excite	1	1.5
Known Web Sites	5	7.6
Bibliographic Databases	6	9.1

Table 6: Level of Satisfaction with the Results (post-search)

Level of satisfaction	Frequency	Percent
Not at all	2	3.0
A little	6	9.1
Moderately	16	24.2
Fairly	26	39.4
A lot	16	24.2
Total	66	100.0

cluding 33,000 participants) the results of which indicated an average success rate of 81% (success defined as "Information Found Every Time" and "Most of the Time" combined) (Sullivan 2000).

The most popular search engine used was Google, a search engine which has become "not just the world's most popular Internet search engine but a verb, a household word and a cultural phenomenon" (Serjeant 2004). According to a survey of share of visits to search engine sites conducted by Hitwise, in April 2004, Google was the mostly visited Web search service among US Web surfers with a share of 15.3% (Sullivan 2004). Other studies of student Web information seeking have also reported that Google is the first engine of choice and the "first port of call when locating information" on the Web (Griffiths & Brothy 2002). More recent research conducted by Nielsen/Netratings confirms the growing popularity of Google, which was used for 55.8% of all Web searches conducted in February 2007 in the United States (Sullivan 2007).

Table 5 shows search engine preference for the sample. The preference towards Google was ascribed to both its effectiveness as well as the simplicity of its interface, which has a high level of

only 9.1% (n=6) had been using Web search tools for less than one year (see Table 3).

Perceived quality of Web search engines and information retrieval satisfaction

Prior to searching the students were asked to rate the quality of search engines as tools for retrieving Web-based information (on the basis of a five point scale from 'very poor' to 'very good'). Results are shown in Table 4. The majority of the students, (57.6%), considered the overall quality of search engines to be good, a finding which is consistent with one of the most extensive (although older) surveys conducted to date on user satisfaction-administered by NPD New Media Services (in-,

Table 7: Level of satisfaction (post-search) crosstabulated with assigned responsibility for results

		Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
		65	98.5%	1	1.5%	66	100.0%

			Assigned responsibility for result			Total
			User	System	Both	
Level of satisfaction (post-search)	not at all	Count	0	1	1	2
		% within Level of satisfaction (post-search)	.0%	50.0%	50.0%	100.0%
	a little	Count	3	2	1	6
		% within Level of satisfaction (post-search)	50.0%	33.3%	16.7%	100.0%
	moderately	Count	5	3	7	15
		% within Level of satisfaction (post-search)	33.3%	20.0%	46.7%	100.0%
	fairly	Count	6	11	9	26
		% within Level of satisfaction (post-search)	23.1%	42.3%	34.6%	100.0%
	a lot	Count	1	10	5	16
		% within Level of satisfaction (post-search)	6.3%	62.5%	31.3%	100.0%
Total		Count	15	27	23	65
		% within Level of satisfaction (post-search)	23.1%	41.5%	35.4%	100.0%

functional complexity but is hidden from direct view (Marissa Mayer 2002). Students expressed a predominant feeling of familiarity and a sense of 'knowing', which impelled them towards using repeatedly the same search engine. Hence, they would "start with Google" and "keep on using Google" because it was something they "know", and felt "a sense of being "drawn" or "stuck" to it, "a kind of affinity":

> I've been using Google for so long and I would very rarely go and look other search engines ... that maybe is silly but I'm happy when I use Google. (Participant #8)

Loyalty to a particular search engine is not a newly reported phenomenon. Hawk and Wang (1999), in an earlier study of problem-solving on the Web found that "some engine users use their engine of choice on a regular basis and with great affinity ... The verbalisations often include an affective element when participants select a search engine." Loyalty in the present study, however, was also associated with the expectation that using a particular search engine would always lead to a successful search outcome regardless of the type of topic sought or the search approach followed.

The participants used "usually" and "normally" the same search engine (Google) every time they searched for information on the Web [1] and expected to "always get relevant information" and "find all the information [they] need".

As was expected from students' predetermined belief that a search using a favourite search engine habitually is usually a successful search, the majority of participants, after the completion of the search session, reported high levels of satisfaction with the overall outcome of the search ("fairly" and "a lot") while only a small proportion of students' responses (less than 10%) were connected to low levels of satisfaction ("a little" and "not at all")(see Table 6). However, when high levels of satisfaction ('fairly and 'a lot' satisfied, n=42) were examined in terms of self or system effectiveness (see Table 7), it was found that the majority of students had higher confidence in the performance of search engines (n=21) rather than their own information-seeking tactics (n=7), a phenomenon which could not be explained as the product of less system experience (see Table 8).

In order to understand the reasons behind this lack of self-belief that students demonstrated in

Table 8: Experience in Using Search Engines among Students with Lower Self-confidence

Experience	Frequency	Percent
0–1 year	1	4.8
1–2 years	6	28.6
2 years and more	14	66.7
Total	21	100.0

their own search strategies it was important to not only examine the information seeking behaviour of those with high levels of satisfaction ('fairly' and 'a lot') during the search task but also to understand how students reflected on that behaviour. In particular, the analysis sought to elaborate strategies for articulating a search question (pre-search planning) and methods used in formulating the search query (search syntax, simple and advanced searches).

Search strategies

Among the information literacy skills recommended by CILIP (Chartered Institute of Library and Information Professionals) are the ability to "to articulate a question and so develop a focus for the research" which requires understanding of the search subject and its component elements, and the ability to "search appropriate resources effectively" which implies knowledge of the optimal search strategies necessary to retrieve the needed information. However, the interactive nature of the Web often supports the belief that there is no need to plan searches before hand (Fidel *et al.* 1999). Thinking about the appropriate search terms to use and deciding upon a specific searching methodology is a step that is disregarded or underestimated when using search engines. The assumption is that information-seekers will be in a position to formulate their information need using a set of appropriate search terms and will be aware of the most appropriate information-seeking tactics and strategies required to retrieve the required information with minimal effort and without adequate system support.

Articulating a search question

The research design of the study encouraged students to think in advance about their information needs as one of the prerequisites before performing the Web search task was to offer a description of the search topic. This allowed for a comparison between expressed information needs (captured before the search) and the search terms used during searching, which provided valuable information about how the students initially conceptualised the topic and how they subsequently searched for it, which aspects of the topic they put emphasis on and whether the search terms used captured their described information needs. In order to explore the depth and coverage of information requests the most significant facets of all information-seeking topic descriptions submitted by the students were extracted and carefully compared to the search terms used by those students during information retrieval. From this analysis it was found that in several information queries significant facets of the information needs described by the students in the pre-search questionnaire were omitted. For example, one participant was looking for specific information on "The Euro Debate", which was expressed as an interest "in background information on government policies, the five tests, to assess whether or not the UK will opt for or against joining the European Union" and "Background and current findings on where the UK stands at present". Despite the very specialised nature of the topic, the query sent to the search engine used was in a very generic and simplified form: "euro debate" (participant #25). Similarly another student searched for "information on medical school libraries in relation to their use of the Internet" indicating that they were "specifically interested in the benefits the Internet brings to the organisation" (participant #5). However, the terms "Internet" or "Internet use", which were of critical importance, were not used at all in any of the searches conducted (see Table 9).

Instead of devising a structured plan in advance, the most common tactic followed by the students was to commence with "typing straight in with a generality" (participant #36). The search terms were then refined, restructured or changed as the search progressed and as new knowledge on the subject was acquired from examining the initial retrieved results. This was supported by the expectation that even the most basic search terms would return "other words and other things or other references to check" (participant #26) and "as you generally hit sites from your first try you get more context" (participant # 7). Table 10 illustrates the evidence from the responses.

Table 9: Comparison between expressed information needs (pre-search) and search queries

Expressed information need (pre-search)	Search terms and search engine used
Participant #5. *I'm looking for information on Medical school libraries in relation to their use of the Internet. I'm specifically interested in the benefits the Internet brings to the organisation. I need to look at Medical school libraries in general, generic info. References to available monographs, full text articles, as up-to-date as possible. Reports. I need to look at several examples of this type of organisation. Also relevant information on search tools + techniques. Information from reliable sources as well as grey literature (reports, papers, etc.). I need this information for a course assignment.*	medical school libraries UK medical school libraries **Google** **Simple search**
Participant #7. *Citizenship in the UK/dual citizenship US/UK. Instructions for the naturalisation process for permanent residents. Forms, dates, fees, addresses, what to do to begin application process.*	dual citizenship UK US UK dual citizenship UK immigration US law dual citizenship **Google** **Simple search**
Participant #10. *I'm looking for information on the life and work of Bon Jovi. I'm hoping to find information on their tour next year and their new album. Specifically I need to know the name and dates for their tour so I can book tickets. Also I want the name of their new album to purchase it.*	Bon Jovi **Yahoo** **Simple search**
Participant #11. *Looking for information on the dog, lurcher breed. Information on the history of this breed. Contact details of breeder/owner clubs, information on keeping a lurcher e.g. diet, exercise.*	"dog breeds" "dog breeds" and lurchers lurchers and their care **Yahoo simple search**
Participant #20. *I am looking for information on the legends of King Arthur and any recent publications about research into historic plausibility. Hopefully, a few academic articles or monographs. A website. I want to find out if any research has been done recently on the kings of Britain – Geoffrey of Monmouth, not popular sci-fi material.*	king arthur king arthur alan lupac alan lupac **Google** **Simple search**
Participant #21. *Travelling in Japan. What are the most interesting places to go? Tokyo Disneyland. How to apply for Visa? Yokohama, Shinjuku, Ikeburuko. I wish to visit Japan.*	travelling in japan **Yahoo** **Simple search**
Participant #25. *The Euro Debate. Interested in background information on government policies-the five tests-to assess whether or not the UK will opt for or against joining the European Union. Background and current findings on where the UK stands at present. Interested in all data types. Information is needed for forthcoming business economics examination.*	euro debate **Google** **Simple search**
Participant #32. *Diabetes in the elderly. Basic information on diabetes in older people and how it can be managed. Examples of dietary changes, diet plans, etc. in order to help a relative make positive changes to their diet.*	Diabetes in the elderly **Google** **Simple search**
Participant #42. *I'm looking for information on Buddhism. I hope to find information on its history, origins, way of life. Help on mediation. Local groups. Documents, Web materials.*	Buddhism **Google** **Simple Search**
Participant #53. *I am looking for the inadequacy of PSTN and data transmitting. I am hoping to find the problems that appear during the transmitting. Also, technical details. I need problems, such as noise, attenuation and difficulties with WAN networking.*	"PSTN" and WAN Technologies **Google**
Participant #63 *Looking for information on entrepreneurship. Hope to find about the present research done in this area. Hope to find the definitions, concepts. Entrepreneurial activities and process.*	entrepreneurship **Google** **simple search**

Table 10: Dynamic, within search term formulation

Participant	Comment
26	„Even if there is something I know very little about normally something will come up, a lot will happen, something will come up and I'll read it and then it will give me other words and other things or other references to check"
7	"...if I don't know precisely what I'm looking for I think I generally start with something and as you generally hit sites from your first try you get more context"
5	"You can start off with quite a general word and once you get your results and you are looking to a couple of the documents that is when you can start to narrow down your search"
13	"I think you just start off and if there is a word that you are looking for you use one word to see what happens"
30	"I would put in anything and see what it comes up with"
27	"I just put one keyword and then just look at one article and see what other things I want. The article helps me to narrow my choice"

Table 11. Unpredictability of search terms

Participant	Comment
59	„Sometimes you are not sure if the search engines are considering that information in the same way with what you are needing cause just the keywords in your mind might not be that much relevant to this kind of text"
25	„You put in something, you may have some knowledge, but it depends what information you get from this. It might change your knowledge; you might have the wrong understanding"
28	„Sometimes I'm not clear about the topic, what's the words they normally use. Normally, if you try out a few links you'll find out and then change the query"
23	"Even though you typed in the keywords you think are important, the search engine probably has some different ones that you won't realise and it would refer to the results in a different way from the one you expect"

Therefore, defining and understanding an information problem (i.e. the selection and analysis of search terms to be used) was perceived as a dynamic component of information seeking, which was incorporated within the course of the search process. As participants explained, the rationale for following this methodology was partly justified on the unpredictability of search engines' interpretation of the key terms used, even when those seemed fairly straight forward, as there may be "whole lots of meanings in the same words" (participant #18). Thus, they would start searching by extrapolating from pre-established knowledge but would often encounter unexpected results (see Table 11).

Yet pre-search planning is also not adequately supported by the interface design of commercial search engines, which typically guide searchers directly to the query formulation stage, assuming that the average search engine user will be able to effectively articulate their information needs. Inadequate system support in the early stages of information seeking may cause confusion and cause excessive information overload and reduce motivation. According to Kuhlthau (1999) "open access to a vast assortment of information has not helped the user's dilemma and in many cases has intensified the sense of confusion and uncertainty ... overwhelming the user with "everything". Similarly, as Rose (2006) observes, most search engines create "the impression that the user's job is to come up with a single short query that will produce a perfect set of results". As similarly expressed by a student in this study:

> It is all about planning things out really, just a methodical approach that sets everything out, it saves you time in the end. I suppose some of the help files of search engines could be better that way, giving out information instead of just showing how you use Boolean operators. (participant #12)

However, students' reflections on their pre-search strategies and choice of search terms revealed that many favoured the use of unsystematic search term selection strategies and they assigned

Table 12: Minimal effort in pre-search planning

Participant	Comment
13	„I would just sort of ask myself a question of what I need to know and highlight a couple of the key things, like the keywords of the question"
7	"I don't think I'm a very persistent searcher in terms of trying to think of other words. I will generally look up the words that have previously come into mind, not giving as much as I could do that way"
32	"I think of the subject that I'm trying to find out about and just sort of making a list in my head of some keywords, of things that I'm looking for, and then I just type those keywords in and go!"
42	"I'll probably think a few seconds about the term I'm going to use and then see what happens, and if this doesn't get me where I want, then I think, well, what is that I'm looking for, what do I need to see?"
36	"Occasionally I think about it but normally I would just type straight in with a generality...Sometimes I do have to stop, go and think about specifying my search terms more precisely"

Table 13: The impact of training on search strategies

Participant	Comment
5	„Now that I've started this course I've started to use Boolean words as well. But I never did that before. I didn't know it existed."
10	"I find it a lot easier now because of this course. I find it a lot better now that I actually had this training...They taught us about truncation, quotation marks, or that kind of thing....Now I would use advanced search, Boolean operators...Now I know how to define the search and add Boolean operators and it's more likely to go with that. If I didn't get anything before that I would just say well that's all on it but now I know how to search it properly."
37	"I didn't use the advanced search before this course but now I do."
40	"They've taught us about more general searching, and it's Boolean, truncation, finding different terms, all different search strategies before you go on. Very helpful. Yes I make sure that I put an AND or an OR somewhere now. All these things make it so much easier."

less significance to pre-search planning. The most recurrent reason for investing minimal effort in planning a search was the notion that preparing for a Web search contradicted some of the most dominant perceived advantages for searching on the Internet, which are the speed, directness and ease of use it offers. The students preferred to "use the Web to access information because it's quicker" (participant #1) and "you get results straight away" (participant #4). They would go to a search engine because "it saves a lot of time" (participant #12), "information is on your fingertips" (participant #25), and "you can find lots of information really quickly" (participant #30), as opposed to visiting the library or searching on bibliographic databases. Students perceived the use of more methodical approaches in Web searching as time-consuming, because "keywords direct you to immediate information" and the search engine "does part of the thinking for you really" (participant #7). This approach is further illustrated in Table 12.

Formulating a search

Self-instruction may have negative consequences in the learning process as it can lead to constructing incorrect inferences and understanding (Carroll 1998). When people learn through experimentation "they try to learn through error diagnosis and recovery, but errors can be subtle, can tangle, and can become intractable obstacles to comprehension and motivation" (Carroll 1998, 6). Users of Web search engines typically have little or no formal training in how to effectively utilise Web search engines (White et *al.* 2003, 708) and therefore, trial-and-error approaches may be highly responsible for misunderstanding basic search functionalities. If the user is unable to translate their information needs into reliable and valid queries, even "the most powerful algorithms for searching and ranking output are of little value" (Chui 1999). This has been confirmed by various studies of search engine users (Spink & Jansen 2004), which

Table 14: Level of satisfaction (post-search) crosstabulated with query type

			Initial query type		Total
			structured	unstructured	
Level of satisfaction (post-search)	fairly	Count	5	21	26
		% within Level of satisfaction (post-search)	19.2%	80.8%	100.0%
	a lot	Count	5	11	16
		% within Level of satisfaction (post-search)	31.3%	68.8%	100.0%
Total		Count	10	32	42
		% within Level of satisfaction (post-search)	23.8%	76.2%	100.0%
		% of Total	23.8%	76.2%	100.0%

Table 15: Level of satisfaction (post-search) crosstabulated with simple and advanced searches

			Simple and advanced searches in initial query		Total
			advanced	simple	
Level of satisfaction (post-search)	fairly	Count	2	24	26
		% within Level of satisfaction (post-search)	7.7%	92.3%	100.0%
	a lot	Count	2	14	16
		% within Level of satisfaction (post-search)	12.5%	87.5%	100.0%
Total		Count	4	38	42
		% within Level of satisfaction (post-search)	9.5%	90.5%	100.0%

on the whole, portray the average Internet user as unsophisticated and "strikingly unaware" of how search engines operate (Fallows 2005). However, one has to consider whether this conclusion is based on an oversimplification or incomplete interpretation of search engines users' awareness levels, especially in view of the fact that larger studies of Web information seeking do not allow for a more in-depth investigation of individual users and the causes of their behaviour.

In the present study, the participants had received training in information retrieval skills through their course and it was naturally expected that the nature of their curriculum would be largely reflected on their strategies followed (see Table 13). However when the information seeking strategies of students with high post-search satisfaction levels were analysed, it was found, that they had preference towards unstructured queries (i.e. queries which did not include any search syntax such as Boolean operators, quotation marks for phrase searching, truncation symbols) (see Table 14) and the simple search option (see Table 15).

When participants were asked to reflect on their search approaches, it became apparent that the use of unsophisticated search methods was less the product of naivety and more the outcome of conscious choice as the students were aware of the search strategies they followed, and could explain why they had chosen to follow specific search paths. For example, some students questioned the overall functionality of more complex searches, expressing a feeling of distrust and uncertainty about their actual effectiveness:

> I don't normally use Boolean operators and things like that because I find they don't make a whole lot of difference and most searches engines they just stick them in anyway without you having to do it. (participant #6)

> I only used Boolean search operators and I think the results would have been the same if I hadn't. (participant #41)

Similarly other students appeared to be critical about the use of more advanced or complex options explaining that more 'sophisticated' search strategies (e.g. use of structured and advanced

searches) were more "useful" when using specialised bibliographic databases (participant #41; participant #65). Structured queries and advanced searching were considered to be less appropriate or necessary when employing Web search engines, as they could lead to over refinement of search results:

> ... if you did a general, a basic search, maybe the search engine would come back with a hundred items. When you did an advanced search it would maybe only bring back sixteen ... so I find it better to maybe just scroll through the hundred cause it's better than getting a really small amount of things as you may missing out things that you are unsure about. (participant #44)

> Sometimes I don't get that many results. I actually get more with the general search. (participant #47)

This finding is not surprising considering users' probability of error in forming Boolean searches. Research has found that although search results are significantly better when using structured rather than unstructured or simple searching, utilising more complex searching operators may not worth the effort as it is more likely for users to employ them incorrectly (Jansen 2000).

Many students also appeared to be aware of the insufficiency of the search tactics they used. For example, one student reflecting on their search strategy explained that "to be honest I haven't done any sort of complicated enough searches ... my searches are not really involved enough, I think" (participant #5). Two other participants admitted "I wasn't conducting especially 'complex' searches, just typing in keywords" (participant #50), and that searching on the Internet is not "a difficult process" but "my skills I would say are basic" (participant #25).

In addition, some students acknowledged that their search strategy or information literacy skills could be improved (participant #47; participant #45; participant #33). However, as other respondents put it, the particular search tactics followed were the outcome of the "force of habit" (participant #49) and although they had been taught how to use Boolean operators they just did not "usually bother" (participant #49). Thus they chose not to use any advanced or complex searches in spite of being aware of more sophisticated search options (participant #51). In particular, one participant stated,

> I think most of my training has come from the course on how to search properly the web. Initially it was friends that showed me the basics and introduced me to the search engines I always use. Then I came here and I've shown how to search more systematically than I have done before. But I have only used that skills when laziness doesn't work. I always try to just typing in the words or clicking on the icons you know. (participant #51)

Discussion

In this study, despite using simplistic search tactics and following limited search approaches, respondents appeared to be overall satisfied with the search results. Although they were caught in a repetitive loop of surface search behaviour they still felt positive and satisfied with their search experiences because they were comfortable with what was already familiar to them and they had specific expectations from previous interactions with their favoured search engines. However, students had more confidence on the search engines used rather than their own search tactics and this was because they were well aware of the limitations of their search approaches. Simplistic search behaviour was linked to preference towards opportunistic learning (e.g. trial-and-error) and to an overall tendency to exert minimal effort in planning strategies and searching. Furthermore, it was evident that although students were experienced searchers they shared less appreciation for the value of more complex search strategies in the context of search engines.

The results of this study have clear implications for information literacy instruction in the context of Web search engines. If the use of 'unsophisticated' searching behaviour is a choice that derives from a preference towards easy retrieval, it may be necessary to look beyond placing emphasis on developing 'correct' or 'optimal' search skills, and instead focus on the motivational aspects of information seeking behaviour.

According to Zipf (1949), investing minimal effort is a natural human behaviour. Individuals strive to solve their problems using "useful" behaviour that is easy to perform even when that behaviour is not the most effective from the functional point of view. A similar notion has been also suggested by March and Simon (1958). Their theory of 'satisficing' interprets most human decision-making as "concerned with the discovery and selection of satisfactory alternatives" (March &

Simon 1958, 141) or solutions that are "sufficient to meet the individual's desired goals rather than pursue the perfect approach" (Simon 1971, 71). However, minimal effort is mostly likely to occur when minimal user motivation is also present. A useful framework for understanding user motivation can be found in social psychology behavioural theories and particularly in expectancy-value theory. Individuals orient themselves to the world according to their expectations (beliefs) and evaluations, which are a function of the learning process (Fishbein 1968). 'Expectancy' is the "the likelihood that positive or negative outcomes will be associated with or follow from a particular act", while 'value' refers to the value the individual places on the consequence (Mazis, Ahtola & Kippel 1975). The more attractive a particular outcome is the more likely a person will engage in specific behaviour. Thus for "effort" to occur one should value the task and believe he or she can succeed at the task (Small 1997).

When applied to information seeking behaviour the principles of expectancy-value theory suggest that knowledge of optimal search strategies alone will not change principal behaviour unless the individual perceives the value of a given action – that is pursuing a specific course of action is worthwhile. If Web users are not in a position to appreciate the value of more complex search strategies and the limitations of easy retrieval information searching habits will remain the same and instructional efforts will have minimal impact on established behaviour. As long as Web search engine users cannot see why maximising cognitive engagement with the search task is a worthwhile experience they will, most likely, exert the minimum effort possible when searching for Web-based information.

Hence provision of effective training on information literacy skills when using search engines may require a fresh way of thinking and a need to reconsider instructional approaches. An instructional model that addresses motivational aspects of learners and provides a useful framework for increasing the motivational appeal of information literacy instruction is the ARCS Model of Motivational Design, which is informed by different motivational theories and most prominently the expectancy-value theory (e.g. Vroom 1964). According to Keller effective instruction that offers opportunities for attaining knowledge is based

on promoting and sustaining motivation during the learning process via four essential strategies: attention, relevance, confidence, and satisfaction. Attention strategies focus on increasing perceptual arousal through novelty, uncertainty and surprise in instruction that help stimulate curiosity. Relevance strategies present clearly the purpose and objectives of instruction and link them to the learner's particular needs, established experience, understanding, and motives. Keller (1983) explains that learners' "motivation will increase as they perceive the likelihood that the task will satisfy a basic need, motive or value". Strategies for increasing confidence help learners develop positive expectations about their own abilities. For example, learners can gain confidence by experiencing a successful outcome after competing a challenging task. Finally, using satisfaction for motivating learning involves offering opportunities for active involvement, personal reflection, evaluation and positive feedback and reinforcement (Keller 1983).

Conclusion

This study has provided insight into some of the reasons that influence satisfaction with information retrieval results when employing Web search engines. It was found that perceived ease of use and familiarity were important components of user satisfaction. In addition, students had predetermined expectations of the efficiency of the search engines they used, which were developed from past experience and trial-and-error interactions with search engines. Although students were aware of the limitations of their search strategies they placed less value in adopting more 'sophisticated' search approaches and demonstrated little intention, willingness or motivation to change their established behaviour and attitudes which favoured ease of use and unsystematic searching.

The results of this research suggest that information literacy skills training in the context of Web search engines needs a greater emphasis on changing already established attitudes and patterns of behaviour. Although the provision of "training in more efficient searching makes students aware of other approaches" this does not necessarily mean that they "apply what they have learned" (Urquhart *et al.* 2005, 354) or apply it correctly. As it is clear students are not developing

Web information literacy skills independently and are not likely to change their established patterns of behaviour without practical examples they can relate to their existing experience and knowledge. Yet the crucial question here is not simply what particular practical skills should be taught but how a set of higher information literacy skills could be developed; skills that will enable students to make intelligent choices when using search engines, to appreciate the importance of developing sophisticated search strategies and take full advantage of what Web search engines can offer in comparison to other information sources.

The significance of motivation has been recognised in information literacy skills instruction and a few studies have examined the characteristics of instructional methods that motivate student learning (Small *et al.* 1996; Burdick 1996). These studies acknowledge that information literacy is not just a "set of skills" but also an "attitude that reflects an interest in seeking solutions to information problems, recognition of the importance of acquiring information skills, information confidence rather than information anxiety, and a sense of satisfaction that comes from research competence" (Small *et al.* 1996). However, to-date research on the development of information literacy skills has not sufficiently addressed the issue of motivation and its connection to search strategies in the Web environment. More research is needed to understand this complex relationship and the forces that act upon it.

Note

1. A similar observation has also emerged from Maglio and Matlock's behavioural study of Web users. As they explain, "... individuals relied on personal routines when trying to find information. For instance, some participants routinely used a particular search engine, such as AltaVista, whereas others routinely used a particular hierarchical catalogue, such as Yahoo!" (Maglio & Matlock 1999, 156).

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Appendices

Appendix 1: Pre-search Questionnaire

1. How frequently do you use web search engines (e.g. AltaVista, Google, Lycos, Yahoo, etc) in order to find information on the web?

5☐ Daily
4☐ Weekly
3☐Monthly (2-3 times)
2☐Occassionally (a few times every 2-3 months)
1☐Rarely (a few times per year)
0☐Other...
....

2. How much experience in using web search engines have you got?

5☐ 3 years and more
4☐ 1-2 years
3☐Less than a year
2☐Less than six months
1☐Less than a month

3. How would you rate the quality of web search engines?

5☐very good
4☐good
3☐moderate
2☐poor
1☐very poor

4. INFORMATION SEARCHING TOPIC

Please spend some time now thinking of a subject that you would like to search for information on the web using any web search engines of your choice. This should be a TOPIC OF INTEREST TO YOU and it could be anything from e.g. *"The implications of a nuclear explosion"* to *"The life and work of Madonna"*, or even one of your assignment topics. In order not to feel that you are wasting your time in the lab, choose a topic you have got genuine interest in, or need information on. Can you now describe in the space below, in your own words, the subject you have chosen? (this should include a description of your subject, what exactly you are hoping to find, the type of information you need and why).

Example: *"I'm looking for information on the life and work of Madonna. I'm hoping to find out about her music career and especially her latest albums. I'm also interested in her childhood years and the impact of her family on her career. I need specifically the title of her latest album in order to purchase it and full-text materials (e.g. interviews) not just brief references to her".*

Please describe your own topic here:

....
....
....

What are you hoping to find?

....
....
....

Type of information you need and why:

....
....
....

5. Demographic Characteristics

Gender: ☐ male   ☐ female

Age: ☐ 17-20   ☐ 21-24   ☐ 25-28   ☐ 29 and more

Is English your first language?   ☐ Yes   ☐ No

Undergraduate Degree:..

Current course undertaken:..

Appendix 2. Post-search Questionnaire

1.   **How much satisfied are you with the results given by the search engine(s) you used?**

not at all	a little	moderately	fairly	a lot
1☐	2☐	3☐	4☐	5☐

2.   **Is the degree of your satisfaction based upon:**

A. Your own performance?

not at all	a little	moderately	fairly	a lot
1☐	2☐	3☐	4☐	5☐

B. The performance of the web search engines(s) used?

not at all	a little	moderately	fairly	a lot
1☐	2☐	3☐	4☐	5☐

Why?

....
....
....

Appendix 3. Interview Questions

Use

- Why do you use search engines?

- What do you think is unique about them if you compare them to some other traditional methods of accessing information?

- When do you use them? (First ones to use or when you have exhausted other sources of information?)

Preference

- Do you have favourite search engines?

- Why do you use those?

- How did you find out about them?

- How did you learn how to use them?

Actions

- Can you describe some typical actions when you search with web search engines?

- Do you use the advanced options? When?

- What would you do if you couldn't find the information you wanted? Do you tend to change your query often? How do you broaden or narrow your search?

- Do you use many search engines for the same topic? Do you use different search engines for different topics?

- Do you think about the subject and then proceed to construct queries? Do you ask for external help first (e.g. help file, people)?

- Do you have difficulties in finding the right terms to express the topic that you need information on? How do you cope with that?

Problems

- Can you give some examples of problems you have encountered when you used search engines? (e.g. not sure how to form a query, too much information retrieved, irrelevant information)

- How did you get over them? (e.g. use of thesaurus, reformulation of query, browse to learn more about the subject, ask for assistance, read help files, try other web search engines).

- Can you make any suggestions on web search engines' improvement? What are they lacking?

- How easy do you find the process of finding online information by using web search engines? How do you cope with very specialised subjects? Is it time-consuming?

Training

- Did you have any training on how to use search engines?

- Are your tactics different after the training provided?

- Is there anything you thing you need more training on?