Engaging with scholarly digital libraries (publisher platforms): The extent to which 'added-value' functions are used

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Abstract

The third paper to emanate from Ciber's Virtual Scholar research programme, which looks at the information seeking behaviour of academics and researchers in regard to digital journal libraries (publisher platforms). This paper concentrates on the users and usage of Blackwell Synergy's 'added-value' functionality. Nearly a million users, making 10 million item requests were investigated employing deep log methods, developed by the authors to provide robust and big picture analyses of digital information consumers and their behaviour. Through such methods usage data has been embellished with user data (for 500,000 people), so enabling comparisons to be made between the information seeking behaviour, for instance, of students and staff, academics and practitioners. We believe this is the first time this type of analysis has been attempted with logs. In this paper we concentrate on those things that users do in a digital library that goes beyond simple use and browsing (constructing interest profiles, employing pop-ups, requesting articles by email and using the search engine). This tells us something about how strongly the users engage or interact with the digital library by benefiting from or exploiting all its functions and whether it is cost effective for publishers to provide, what appears to be a never-ending number of facilities.
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1. Introduction

There has been a very welcome increase in the number of research investigations into the use of digital scholarly journals or publisher platforms. Indeed, Tenopir (2003) has identified and reviewed more than 200 such research studies published between 1995 and 2003. However, a good number of these studies are small-scale and because of their age do not reflect the realities of today's digital environment in which huge digital libraries and Big Deals operate. We believe that a new method, 'deep log analysis', provides for a larger and much better grip of what is happening. Deep log analysis refers not simply, as the name suggests, to mining the data more deeply and accurately than proprietary software can achieve, but also to the relating of 'usage' data to 'user' data to provide the all important context and triangulation. What we then report here is the results of a six-month long deep log investigation of the use and users of the Blackwell Synergy[2] digital library—an interdisciplinary digital library offering, at the time of the research (Winter 2003) around 700 full-text scholarly journals and 368,000 full-text articles. This is the third paper to emanate from this investigation, the two others are by Nicholas, Huntington, and Watkinson (2005a) and Nicholas, Huntington, Watkinson, Jamali, and Hamid (in press).

2. Aims and objectives

The broad aim of the paper is to provide a detailed and robust description of digital scholarly journal users and their information seeking behaviour employing deep log methods to obtain a richer picture than is provided by proprietary software (see Section 4 for an explanation of this methodology). It has three main objectives:

1. To determine the extent to which the added functionality offered by digital libraries—at some cost to publishers—is actually used. By additional functionality we mean, those things that are offered to users in a digital library that goes beyond simple use and browsing. Such an evaluation would tell us something about how strongly users of scholarly journals engage or interact with the digital library by taking full benefits of all its functions. There is an almost inevitable, systems-driven move to enhance digital libraries with all kinds of functions and there is a need to discover how users—and which users, take advantage of these functions. In other word what is needed is a strong dose of reality that usage data furnishes only too well. The Blackwell logs enabled us to investigate use of four functions: the search engine, (subject interest) profiling, email requests for articles and use of pop-ups (to view diagrams and figures).

2. To characterise and categorise scholarly journal users by occupational status, place of work and referrer link used in order to determine differences in the utilisation of the above functions.

3. To demonstrate the potential of a relatively new methodology, 'deep log analysis', in mapping and evaluating the behaviour of the users of digital scholarly journals. This methodology was first developed in the digital health field (Nicholas, Huntington, & Williams, 2004) and we use it here to demonstrate the rich harvest the raw logs yield.

3. Literature review

A whole range of methods have been employed to assess the use of digital libraries, typically online questionnaire surveys (Rusch-Feja, 1999), and interviews/focus groups (Bonthron et al., 2003). Online surveys

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[2] http://www.blackwell-synergy.com.

are ubiquitous, log transactions studies are not so common, but on the increase (Gargiulo, 2003). The use of different methods makes comparison and establishing a consensus difficult.

The results of previous studies have shown that there is general enthusiasm for searching digital journal libraries. The feedback obtained from those who searched for journal articles using the Internet Library of Early Journals service (ILEJ, 1999) indicated general satisfaction with, and enthusiasm for the service. In addition, users of the BUILDER electronic journals service were invited to indicate their opinions concerning the whole idea of an online journal. Most respondents suggested that the idea of online journals was a good one, for instance: 'This is the future of learned journals' and 'Very informative with use friendly access' (Dalton & Nankivell, 1999). Similarly, most DECOMATE users were positive about the concept of having online access to a number of journal titles (Jenkins, 1997).

Regarding the digital library users' search abilities and their searching success, there is a large body of literature suggesting that most end users have limited capabilities and not progressed much. They tend to adopt a relatively simplistic approach to searching and limited use of Boolean operators or other advanced searching techniques, such as the thesaurus. King and Moffat (1996) showed that they made unsophisticated searches. They preferred direct searching tended to use single keywords and rarely used Boolean operators (AND, OR and NOT). Over the test period of the service 2818 search or browse transactions were registered on the server of EEVL gateway of which 63% were searches and 37% browses. End users said that searching with keywords is more likely to produce the documents they are actually seeking. However, those who used browse facilities (using contents pages etc.) they also faced difficulties in using filtering options that could help them to reduce the number of "hits" returned.

However, more recent studies—suggesting may be things had changed, are generally agreed that browsing seems to be the favourite method when using electronic journals (Eason, 2000; Eason, Yu, & Harker, 2000; Monopoli, Nicholas, Georgiou, & Korfiati, 2002; Tenopir, 2003). Browsing and chaining (following up bibliographic references already known) was also a popular method (Talja & Maula, 2003). In addition, Tenopir and Donald (2001) identified five basic ways for reading scholarly articles: "browsing, automated searches, citations found in the literature, mentions by other people and current-awareness tools". Finally, Talja and Maula (2003) conducted a qualitative analysis of the use and non-use of electronic journals between four academic disciplines: literature/cultural studies, history, ecological and environmental and nursing studies. They noted that in the literature/cultural studies scholars relied mainly on "browsing and chaining" of electronic resources. In nursing studies, electronic resources use was very high and the information skills of the scholars quite advanced. They tended to use direct searching rather than browsing and they kept going back to their preferred databases to check on new items.

Monopoli et al. (2002), in order to obtain more details on the searching method employed by electronic journals users, asked users to specify which search (search engine) or browse options they used. There are some basic searching services provided to every digital library, such as search by journal title, by author, by date of publication and by contents page. Results of a survey conducted at the University of Patras indicated that there was a very good spread of use of all search options amongst the 239 people who responded. However, the most popular search was the 'keyword' search (73.6% of respondents preferred this method). The second most popular option was 'author' (48.1%). The least preferred method of searching was 'date of publication'—only 10.9% of the respondents indicated this option. Finally, concerning the use of the thesaurus, the study of the Art, Design, Architecture and Media (ADAM) gateway (Ferry, 1996) revealed that the use of thesaurus was very low indeed. Despite the fact that the use of advanced searching techniques, such as Boolean operators and the thesaurus was low, few users seemed to need to call upon support/help services and functions. Ironically, when asked, users say that online help and generally any kind of instructions provided to users on how to use a system to its full potential are very important. Thus 45% of Social Science Information Gateway (SOSIG) respondents valued them as very important of important facilities (Monopoli & Nicholas, 2000). Regarding the reasons for non-use of online help, the most cited one was that users had not felt the need for help yet. Though, there were also users who mentioned that they did

not know that online help was available or they did not know what online help was (Monopoli & Nicholas, 2000; 2001; Monopoli et al., 2002).

Finally, Eason et al. (2000) found that regular users of electronic sources and scholars possessing advanced computing skills were more likely to explore more features of the electronic services.

4. Methods

The paper is as much about the power of a particular methodology-deep log analysis, to yield robust usage data as it is about describing and evaluating digital information seeking behaviour of the virtual scholar. To this end we preface the description of our specific data collection methods with a more general explanation of deep log analysis.

4.1. Deep log analysis

Deep log techniques were developed by the researchers during work conducted for the Department of Health (DoH) in evaluating the roll-out of digital health services to the nation (Nicholas et al., 2004). The techniques were born as a result of the frustrations experienced in trying to employ proprietary log software to provide us with the very big picture analysis that DoH (and other) policy makers require. Raw log analysis offers a much more relevant analysis. Proprietary software, by definition, provides a report with pre-defined parameters, raw log analysis can hone in for a depth analysis on items that appear to be relevant. Raw log analysis raises more questions. Proprietary software restricts analysis to descriptive single variable statistics. Raw log analysis provides relevant two or even multivariate analysis. Furthermore, proprietary software tends to deliver unreadable, non-user friendly reports that give endless pages of unrelated and often meaningless data. Raw log analysis delivers meaningful and focussed reports.

All digital information platforms have a facility by which computer transaction logs provide automatic and real-time record of use by everyone who uses them. They represent the users' digital information footprints. By analysing them you can track and map their information seeking, and, when enhanced by user demographic data (as we do in this paper), they can tell us much about the kinds of people who use the services and the outcomes that result from its use.

The attraction of logs is that they provide abundant and fairly robust evidence of use. With log analysis it is possible to monitor the use of a system by millions of people, around the world. Logs record use by everyone who happens to engage with the system—there is no need to take a sample. The great advantages of the logs are not simply their size and reach, although the dividend here is indeed a rich and unparalleled one. Most importantly, they are a direct and immediately available record of what people have done: not what they say they might, or would, do; not what they were prompted to say, not what they thought they did. The data are unfiltered and speak for themselves and provide a reality check that both represents the users and complements important contextual data obtained by engaging with real users and exploring their experiences and concerns.

In cases where log analysis has been employed in the digital library field researchers generally have used processed data obtained from proprietary software (Gargiulo, 2003). In such circumstances, inevitably, the analyses are constrained by the software. Instead of the log gathering exercise being powered by the big policy questions that are confronting us all about the role of digital information provision in academe, too often the enormity of the data proves overwhelming. Therefore, after the initial euphoria that greeted the arrival of web-log data a general frustration has crept in as people realise that they are still without critical intelligence on the user that, as we shall argue, deep log analysis furnishes.

Clearly the ubiquitous metric 'hits'—page impressions, the chief currency of proprietary log software, can only get us so far—not very far in fact, when everyone quotes such enormous hit figures. It is also clear

that usage logs alone are not the magic bullet, but they are the essential methodological first step. Deep log analysis in best viewed as a four-step process. Firstly, the assumptions on how the data are defined and recorded (for instance, who is a user, what is a hit etc.) are questioned and re-aligned as necessary, and their statistical significance assessed.[3] This is important, as skewed data is a real problem. This ensures both that incorrect, over-inflated readings that give a false sense of achievement/progress are avoided. Secondly, the raw data are re-engineered to provide more powerful metrics and to ensure that data gathering is better aligned to organisational goals. The third step is to enrich the usage data by adding user demographic data (e.g. occupation, subject specialism), either with data obtained from a subscriber database (ideal) or online questionnaires (not so ideal, as user data cannot be mapped so closely on usage data). Of course, logs and user databases enable us to map the digital environment accurately but provide little in the way of explanation, satisfaction and impacts. They do however raise the questions that *really* need to be asked by questionnaire, interview and observation to explain information seeking behaviour, and that is the fourth step in our analyses. The research reported here has progressed to only the first three steps, the fourth step is currently being planned and results published later.

4.2. Data collection

Raw server transaction logs for February–March 2003 were subject to deep log techniques, parsed and processed by SPSS. Standard usage (e.g. type of requests made, time spent viewing) and deep log analyses (site penetration and returnee) analyses were generated. For full details of the methods see Nicholas, Huntington, Lievesley, and Wasti (2000). A pilot analysis of data for 17th September 2003 informed and honed this analysis, and the head-line data from the pilot was reported to the Charleston conference (Nicholas, Huntington, Rowlands, Russell, & Cousins, 2004) and is selectively referred to in this paper. The size of the datasets were enormous, recording about a million users and 10 million item requests over the two months. Nevertheless, it is just a couple of month's data that we are reporting on and our results should be looked at in this light.

4.3. Working definitions

4.3.1. User

User identification was based on a combination of "IP" number and browser details. A user was effectively a computer; sometimes that computer represents an individual (i.e. a professor in his office), in other cases a number of people (i.e. students in the library). On average, about half a million people visited the Blackwell site a month—445,149 users visited in February and 512,661 in March 2003. User background data (on occupation, organizational affiliation and geographical location) held on a registered user database was related, via an identification number, to the usage logs generated in February 2002 by registered users. The user database contained records of over 500,000 registered users.

4.3.2. Use

Two use metrics were employed: (1) search sessions conducted and (2) items viewed or requests made.

- *Search session*: Each access is allocated a session number and this is a unique number, which accurately defines a user session. Logs include a session beginning tag and a session ending tag, which enables us to make time calculations as well.

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[3] A process made easier by COUNTER, who are standardizing the way the industry counts digital use. http://www.projectcounter.org.

- *Items viewed (requests made)*: A 'complete' item returned by the server to the client in response to a user action. This study defined countable page views or item requests to include the list of issues, journal table of contents (ToC), abstracts, article full text viewed as HTML and article full text viewed as PDF. Thus a complete item request would include all the pages, charts etc. contained in an article, and this is recorded as a single item used. This is quite different from traditional server log files that record pictures and text documents separately, and this also explains why we have tried to avoid the term 'pages viewed', as it could be confusing.

Blackwell logs also contain the following elements: whether the person used the site's search engine, created an interest profile, requested an article by email or used a pop-up to see a diagram/figure. It is these elements that are the focus of attention in this paper.

5. Results

We have reported elsewhere on the use of Synergy in regard to site penetration, return visits and types of item viewed (Nicholas et al., 2005a, in press). Here we concentrate on those things that users do in a digital library that go beyond simple use and browsing—the things that publishers hope they will do to in order to become more practised and proficient searchers (and more loyal and dependent users). This should tell us something about how strongly the users engage or interact with the digital library by benefiting/exploiting all its functions. There is an almost inevitable move to enhance digital libraries with all kinds of functions and there is a need to discover how users react to these functions, and whether the investment is worth it from a publisher's perspective.

5.1. Interactivity

Synergy offers users a number of interactive facilities, including profiling (setting up an interest profile), pop-ups (used to view data, charts, figures etc.) and an opportunity to have articles emailed to them. Involvement in all three activities says something about user confidence and experience in using the site. Unfortunately, but tellingly, these facilities were not particularly well used, in each case their use in a search session never exceeded more than 1 in 16 sessions (Figs. 1–3). Just 6% used the profile and pop-up functions
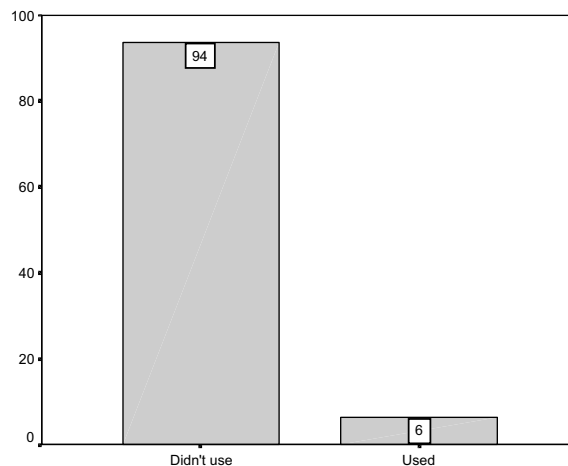

Fig. 1. Session distribution by if the user used the profile function.
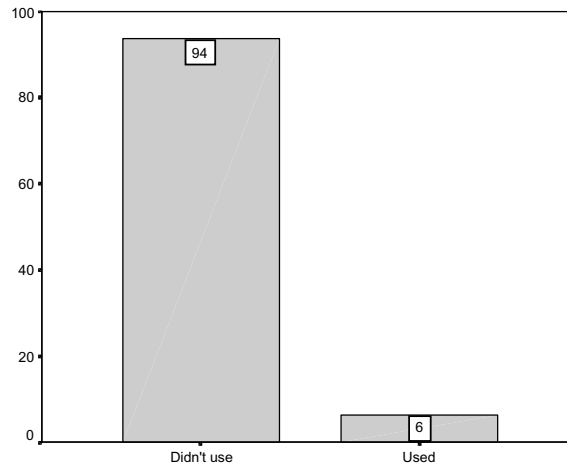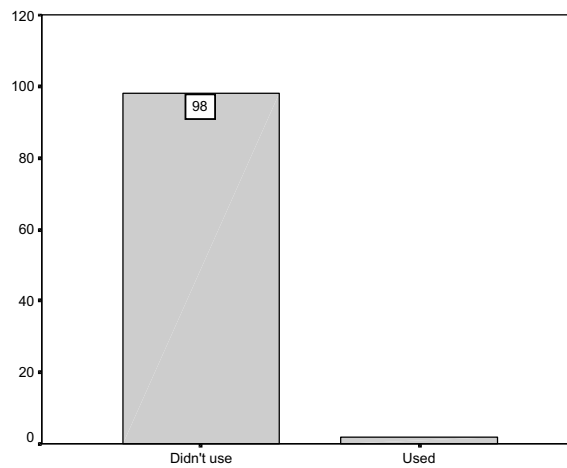
Fig. 2. Session distribution by use of Pop-ups.

Fig. 3. Session distribution by use of Email.

and 2% used the article email service. This analysis is based on subscribers who benefit from the use of these facilities and it is possible that some non-subscribers may well have been included in the analysis. Thus users purchasing an article will be given a temporary user identification number, although these users would not have "full" subscriber rights. It is not thought that the numbers involved would be very significant.

5.1.1. Profiles

In terms of Profiling, just 6% of users took the opportunity of this facility (Fig. 1). Those who had filled out the subscriber form, not all subscribers did this, were more likely to use the profile function, suggesting that those filling out the form associate themselves strongly with the Blackwell digital brand. They same percentage employed pop-ups (Fig. 2), and even fewer people used the email facility, just 4% did so (Fig. 3).
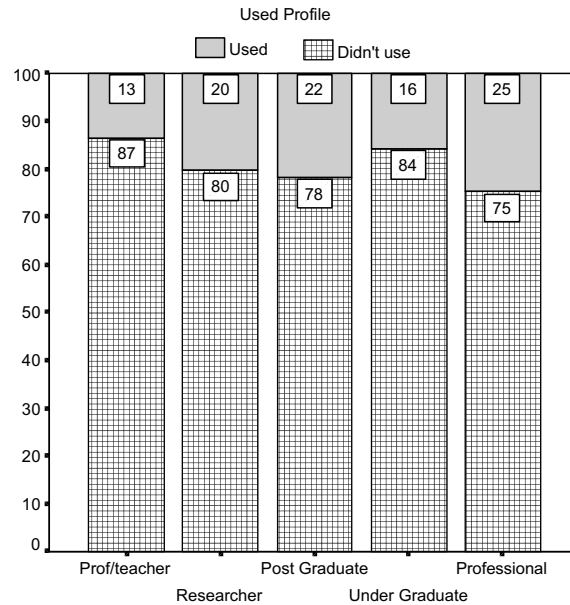
Fig. 4. Use of the profile function by occupation/status of user—subscribers.

Fig. 4 details the use of the profile function by occupation/status of user. Professional/practitioners and postgraduates were more likely to sign-up for a Profile, 25% and 22% did and professors/teachers were least likely to, only 13% had used the function. Profiling is really a current awareness function so this might say something about the perceived need to keep up to date.

Fig. 5 shows the use of the profile function by user's place of work. The use of the profiling function by Government employees stood out, with 37% availing themselves of the function. By contrast less that a quarter of academics did so.

Furthermore, those respondents arriving at the site via a library or Blackwell Synergy were also more likely to use the profile function, 15% and 17% had done so (Fig. 6).

Users conducting longer sessions used the profile facility more. A quarter of sessions viewing 21 or more items had used the profile facility and this was only true for about 13% of sessions viewing 10 or less pages (Fig. 7). This adds substance to our belief that site penetration is a metric useful for denoting experienced users.

5.1.2. Email article requests

Fig. 8 gives the use of the email function by the referrer link status of the user. The referrer link details the site previously visited by the user before arriving at the Synergy site. Referrer links were crudely classified into six categories: other, library portals, journal links, via Blackwell Publishing (the parent site), via Blackwell Synergy (believed to be internal links) and Google. For example, the category journal links was based only on users coming to the site via Journal of Advanced Nursing and Journal of Addiction, as these two were easily identifiable from the logs. However, not all links were so easy to identify, and consequently we have not identified all sessions coming in via journal links. Referrer link proved significant in terms of use of the email service: 11% of those coming in via a library used the service compared to less than 2% for other groupings.
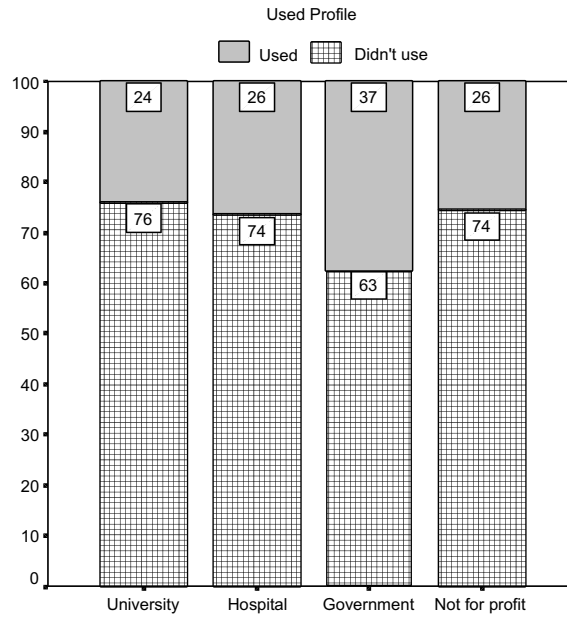
Fig. 5. Use of the profile function by place of work of the user—subscribers.
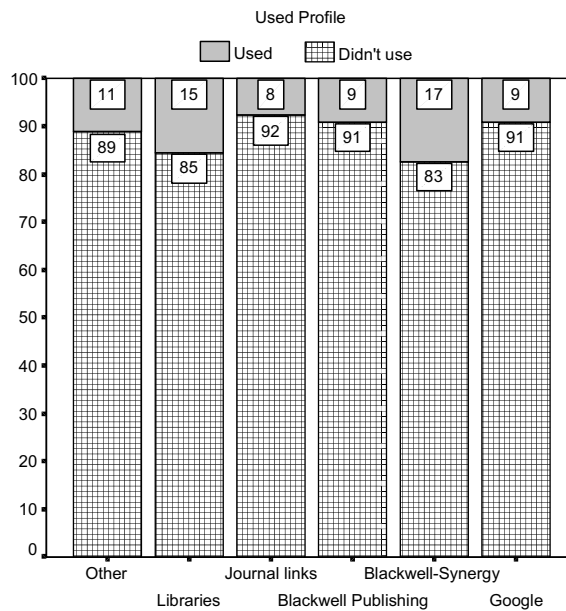

Fig. 6. Use of the profile function use by referrer link—subscribers.

5.1.3. Use of pop-up function

The number of items viewed in a session also appeared significant in determining the use of pop-ups: 17% of those viewing 21 or more items in a session had used the pop-up service compared to less than 4% for those viewing 1–3 items in a session (Fig. 9).
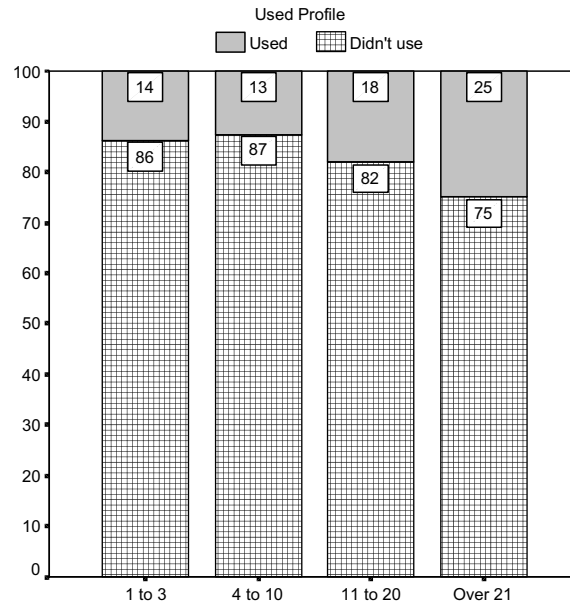
Used Profile

Used ▨   Didn't use ▦

Fig. 7. Use of the profile function by number of items viewed in a session (grouped)—subscribers.
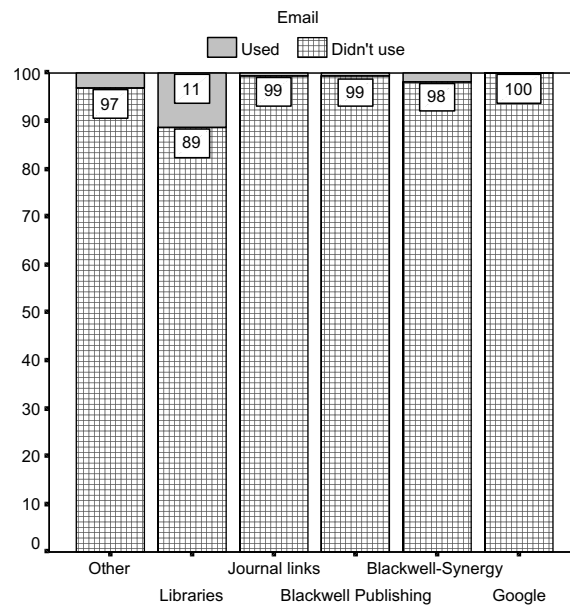
Email

Used ▨   Didn't use ▦

Fig. 8. Use of the email function by referrer link—subscribers.

5.2. Using the internal search facility

Using the search engine provided is another measure of interactivity. We have reported elsewhere that for all user types browsing was the dominant method of retrieving information from Synergy (Nicholas et al., 2005a, in press). Thus around 9 out of 10 sessions conducted did not use the site search engine, people preferred to
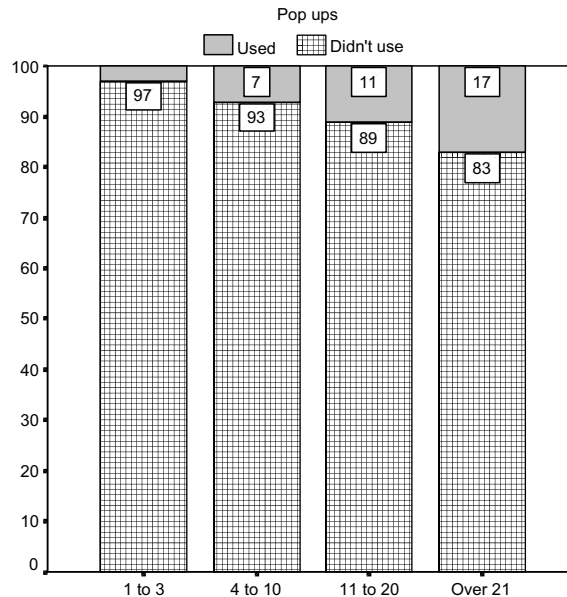
Fig. 9. Use of the pop-up function by number of items viewed in a session (grouped)—subscribers.

browse the table of contents, abstracts etc. or simply directly locate the full-text document they were looking for (Pubmed was the largest referrer, medical and science users found what they wanted from an abstract on Pubmed and just were taken direct to the full text). It is possible that an additional explanation for the relative lack of search engine use could be digital visibility or prominence. The search engine facility is mentioned after the browsing capabilities on the home page and users automatically read the browse capabilities first.

There are some significant findings around what the referred do in regard to information retrieval when they get to the site, depending on where they have come from. So those coming from a library link or a Blackwell Publishing site were most likely to use the browse facilities (and least likely to use the search engine) and those coming from a journal link of Google were the least likely to. This has huge implications for the structure and navigation of the site and would be worth following up with a Witness study on movement of a user around the site as well as a repeat analysis to see how much has changed in these patterns of referrer usage over the year to be able to determine if different users should be presented with different options. That is, if the user arrives from a library site should they be taken more directly to the results, are we frustrating them currently, do they use less of the site as a result? Equally a Google user could be encouraged to go further rather than bounce out if they are presented with something more directly relevant to their needs.

An aspect of user behaviour that tells us something about how strongly users engage with the site is whether they had used the site search facility provided. Figs. 10 and 11 give, respectively, the session and use distribution of whether the user had used the search facility. In all, about 20% of search sessions saw the facility being used, these sessions accounted for 28% of site use suggesting that those using the search facility made more or better use of the site compared to those who had not used the facility. Using the search facility could provide users with rich dividends.

5.2.1. Use of search engine by status of user

Fig. 12 shows search facility use by occupation/status of user. Of the five groupings it seems that, as perhaps expected, undergraduates were the most likely to use the search facility: 46% had compared to 26% of postgraduates, 19% of researchers and 15% of professors or teachers. This is clearly a significant finding.
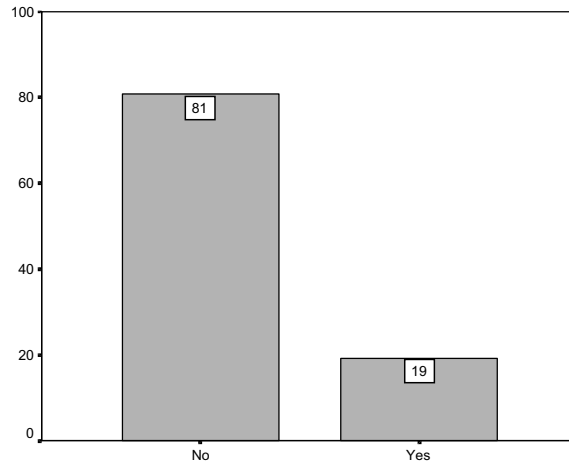
Fig. 10. Session distribution by whether the user had used the search facility—subscribers.
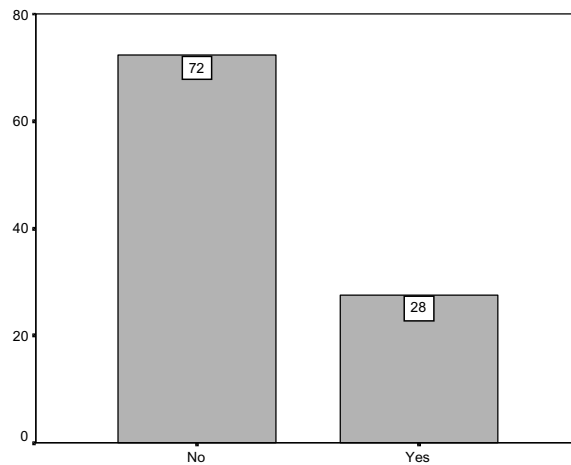

Fig. 11. Use distribution by whether the user had used the search facility—subscribers.

5.2.2. Use of search engine by place of work

In terms of place of work (Fig. 13) those working in government were least likely to use the search facility, only 20% did so, compared to 30% of those working in either hospital or universities.

5.2.3. Use of search engine by referrer used

In terms of the users' referrer link status (Fig. 14) there are enormous differences, those coming into the site via a journal link exhibited both an ability and willingness to use the search facility, 69% had done so. In terms of other groups a third of those entering the site via a library portal and 36% of those entering the site via Google also used the internal search facility.

5.2.4. Use of search engine by depth of penetration of the site

As expected those most experienced in using the site as indicated by site penetration (number of pages viewed in a session metric) were more likely to have used the search facility. Just over a third (38%) of user
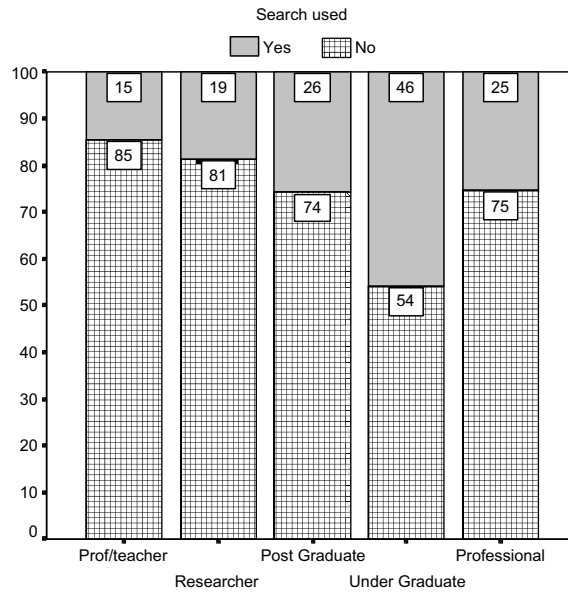
Search used

☐ Yes ▦ No

Fig. 12. Use of the search facility by occupation/status of user.
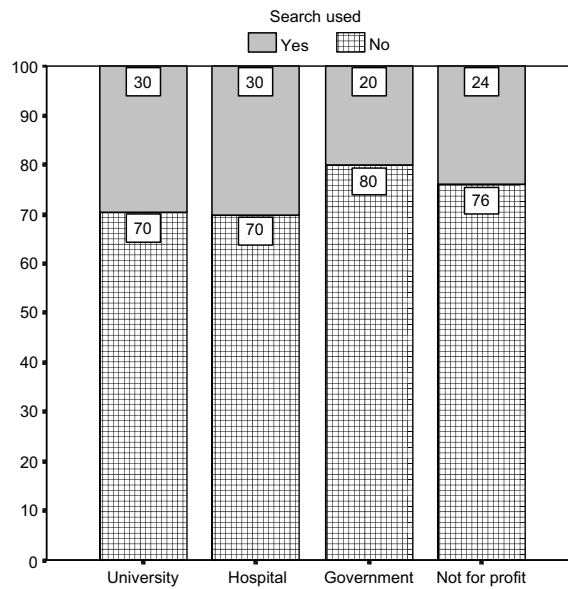
Search used

☐ Yes ▦ No

Fig. 13. Use of the search facility by location place of work of user.

sessions that saw over 21 items views had used the search facility. However, this was only true of 15% of those sessions where three or fewer items were viewed (Fig. 15).
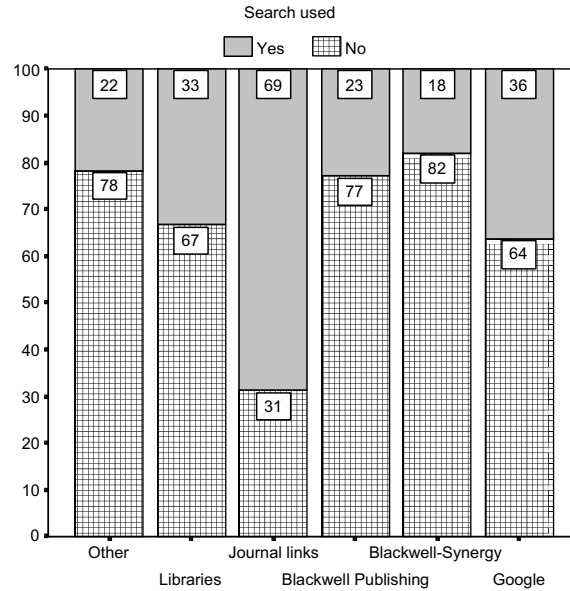
Search used

Yes No

Fig. 14. Use of the search facility by referrer link status of user.
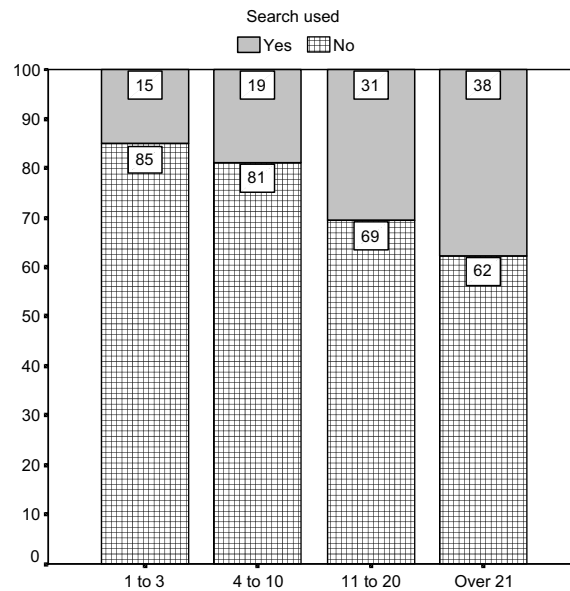
Search used

Yes No

Fig. 15. Use of the search facility by number of items viewed in a session (grouped)—subscribers.

5.2.5. Use of search engine over time

There appear to be some significant changes between the numbers searching by user type over the two survey periods. Overall there was a slight increase in the numbers searching compared to browsing between February and September 2003. In regard to user types, while the numbers of researchers and

undergraduates stayed the same with respective browse-search ratios of 81:19 and 54:46. However the proportion of University Professors searching substantially increased from 15% to 25% and for postgraduates from 20% to 26%. Superficially this looks as though the trend is towards searching (and a student-like form of information seeking behaviour), but a stronger comparative year on year study would be needed to verify this assertion.

6. Conclusions

It is very clear form the study that the vast majority of people did not use the digital library's extra functionality. Three of the functions studied—profiling (setting up an interest profile), pop-ups (used to view data, charts, figures etc.) and having articles emailed, were not particularly well used; in each case their use in a search session never exceeded more than one in sixteen. This is however not surprising in the light of the findings of our two related papers on related aspects of usage for the same digital library (Nicholas et al., in press, 2005a) and, indeed, adds considerable weight to the paradigm of the digital information consumer we have developed (Nicholas, Huntington, Williams, & Dobrowolski, 2005b). Digital information consumers, whether they are scholars or the general public, do not engage very deeply—with any one website, part or function of the website. They are generally characterised by their short attention spans and shallow searching. On its own this might suggest an unsuccessful, uninformed or lazy form of behaviour. However, when taken with some of the other characteristics, like their promiscuous and bouncing behaviour, this suggests a horizontal, flicking, checking, comparing sort of behaviour that is a result of fast and easy access to information, a shortage of time and a huge digital choice.

Use of the search engine was the fourth function studied. Here, too, but perhaps more unexpectedly in an information world dominated by search engines, use of the internal search engine was relatively low with around nine out of 10 sessions conducted not employing the search engine. However, it is possible that the relative lack of search engine use could be due to a lack of digital visibility or prominence, and we have shown elsewhere how important that is in determining use (Nicholas, Huntington, Williams, & Gunter, 2002). Thus the search engine facility is mentioned after the browsing capabilities on the home page and users automatically read about the browse capabilities first. This finding does however reinforce those of Monopoli et al. (2002) who showed that most people prefer to browse the digital library contents.

Generalising about a population of heterogeneous users (undergraduates, and professors; scientists and humanitists) are numbered in their tens of thousands can be dangerous, so we need to look at the results of deep log analysis in identifying differences between user groups and consequently it was the differences in the use of these four functions that probably provide the most interesting findings:

- Professional/practitioners and postgraduates were most likely to sign-up for a Profile and professors/teachers were least likely to.
- The use of the profiling function by Government employees stood out, with well over a third availing themselves of the function. By contrast less that a quarter of academics did so.
- Referrer link proved significant in terms of use of the email service: one in nine of those coming in via a library used the service compared to less than one in fifty for other groupings.
- Undergraduates were the most likely to use the search facility—nearly a half did so compared to less than a sixth of lecturers, a finding which suggests that academics know their way around the literature, whereas students come with little knowledge and trust the search engine to guide them in these circumstances.
- Those working in government were least likely to use the search facility, only one in five did so, compared to just over one in three of those working in either hospital or universities.

- Perhaps, most significantly, heavy or busy users tended to use all the functions most. There is clearly a need to identify who these heavy users are and we have begun to do this elsewhere (Nicholas et al., in press).

Qualitative work is currently being undertaken on a study of OhioLink[4] which will help us answer why the digital library's functions are not being used and to explain the differences in use between user groups.

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