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Understanding student information behavior in relation to electronic information services: lessons from longitudinal monitoring and evaluation. Part 2

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Understanding student information behavior in relation to electronic information sources: lessons from longitudinal monitoring and evaluation. Part 2

Abstract

This second part of a two-part article establishes a model of the mediating factors that influence student information behavior concerning the electronic or digital information sources used to support learning. This part discusses the findings of the JISC User Behavior Monitoring and Evaluation Framework (1999-2004) and development of a model that includes both the individual (micro) and organizational (macro) factors affecting student information behavior. The macro factors are information resource design, information and learning technology infrastructure, availability and constraints to access, policies and funding, and organizational leadership and culture. The micro factors are: information literacy, academics' information behavior, search strategies, discipline and curriculum, support and training, and pedagogy. Concludes that the mediating factors interact in unexpected ways, and that further research is needed to clarify how those interactions, particularly between the macro and micro factors, operate.

Keywords: User behavior; Information behavior; Digital information resources; Electronic information services; Information use; User surveys.

1. Introduction

Part I of this paper discussed the methodology for the Framework study of the way students used electronic information services in colleges (community colleges) and universities in the UK. The methods were adapted as the Framework evolved to meet the needs of the sponsors, the Joint Information Systems Committee of the Funding Councils in the UK. The resulting data set therefore comprises longitudinal data on the use of electronic information services by students, as well as some smaller scale studies such as action research pilots working with academic staff and library staff to gain a better understanding of the factors influencing use. Similarly, inductive observation of some common problems across institutions was investigated in data mining of the qualitative data at particular points in the study, to understand the antecedents of the problem and propose some solutions. At the conclusion of the study, further analysis was conducted to derive an information behavior model that attempts to bridge the divide between the research that focuses on the individual (in context) and the research that focuses on the organizational issues that concern the educational institutions, publishers and the bodies responsible for the technical infrastructure. The word model is used in the sense of being 'an external and explicit representation of part of reality as seen by the people who wish to use that model to understand, to change, to manage and to control that part of reality.' (Pidd, 2003, p.12). This part 2 of the paper first contextualizes the model relative to other models of information seeking behavior and the successful use of information systems and explains the stages in the development of the model. The information behavior model is then presented and its elements defined. Evidence to support the inclusion of the various elements in the model is then marshaled under the elements in the model. Whilst this order goes counter to the conventional order in research papers of reporting findings and evidence and concluding with the model, the order adopted in this paper makes for a more accessible dissertation. The paper concludes with discussion of the contribution made by the Framework research and the model, and an identification of areas for future research. One key area for future

research lies in the further investigation of the complexity of the interaction between the micro and macro factors governing information behavior.

2 Model development

The *Information Behavior Model* seeks to offer a model that is additional to existing models in the information seeking and use fields. As discussed in the Literature review in part 1 of this paper, Kulhthau's model of information seeking has been influential. It identified six stages of information seeking: task initiation, topic selection, pre-focus exploration, focus formulation, information collection, and search closure. It does not however present the factors that influence the development of the search process, focusing instead on the stages in the process. Foster's nonlinear model also focuses on the core processes of information seeking (Foster, 2004). Other frameworks (e.g. Wilson & Walsh, 1996) identify the influences and constraints, or the dimensions of some types of information seeking such as browsing (Rice, McCreddie & Chang, 2001). In the information systems field, the updated model of DeLone and McLean (2003) is aimed at understanding successful use of information systems within business. As it provides an organizational, not an individual perspective, its scope is wider than that of the information seeking studies cited above, and it covers similar territory to the *Information behavior Model*. The updated model has dimensions for *information quality*, *system quality*, *service quality*, which each affect *intention to use (and use)* and *user satisfaction*. There is a synergic relationship between intention to use and user satisfaction (more satisfaction, more propensity to use) and the *net benefits of use*, also affect satisfaction and use (with higher net benefits, satisfaction levels and intentions to use likely to increase). This model has the advantage of providing a framework that proposes associations that can be tested, but the framework is based on research on management information systems and uses a conceptual space that is alien to other research on student information behavior. For electronic information services in general, such models do not focus on the individual and their reasons for choosing to use, or not to

use particular services. The element of individual choice, although influenced by context, is assumed in most models of information behavior that focus on information seeking and use.

Sections, 3.1 and 3.2 in part 1 of this paper, focus on how data was collected and analyzed for distillation into annual reports. These reports offer detailed summaries of the findings under the project including both quantitative data, and qualitative insights. It also promoted the development of taxonomies and frameworks to structure and interpret the data collected during the research process for the purpose of reporting and disseminating findings. This work acts as an important foundation for distillation of understanding that has led to the proposal of the *Information Behavior Model*. Other important preparatory stages in this process were:

1. The preparation of a variety of briefing papers for committees and library and information service managers during the various cycle of the project (JUBILEE, 2004; JUSTEIS, 2004)
2. Presentations and dialogues with other researchers and practitioners at various dissemination events held by the project teams, or at other conferences
3. Publications in a variety of academic and professional journals (Banwell et al., 2004; Rowley, 2002, Rowley et al. 2002; 2004; Urquhart et al., 2003; 2004)

Together these led to the first draft of a model of the factors that influence student information behavior, which is captured in the structure of the Action Plan for HE managers, and the structure of the various documents and presentations. However at this stage there was no agreed and consistent articulation of the factors to be included in the model, and their description and labeling needed further attention. Accordingly the following stages were undertaken to draw out a clear picture of the factors impacting on student information behavior:

1. Proposal of draft model
2. Further data mining of data sets to:

- a. check for comprehensiveness and precision of the model in terms of alignment of its use of terminology with terms used by respondents
 - b. collect evidence for specific assertions in the findings section below, and as a basis for conclusions and recommendations
3. Proposal of revised model
 4. Verification of the model by exposing it to ten past members of the project team.
 5. Proposal of the final version of the model.

One of the research teams focused on the barriers and enablers to use of electronic information services in the development of a toolkit, and the development stages were designated *Baseline, Change, Congruence, Embedding, and Full integration*. The themes within those stages were refined as the research developed and the final themes selected by the JUBILEE team were: *access; liaison between library and academic staff; training; integration of electronic information services into the curriculum; user behavior*. This approach to a toolkit is helpful in helping academic libraries assess whether their digital library services are becoming more effective. The limitations concern the assumptions made about the ideal state of full integration, and the infrastructural factors that have a major impact on the themes. One size may not fit all, and an institutional information behavior model needs to reflect some of the organizational and strategic influences that may shape how a department in a large research intensive institution successfully approaches the effective use of information resources by its students, but in a way completely different to the approach used by a smaller college. The research findings from the JUSTEIS data provided the data that helped, where necessary, to refine the themes, and add in the organizational factors that need to be included.

In summary, the stages in development of the model were a series of dialogues. There were dialogues within the research teams (e.g. on the meaning of information quality, the need for promotion of services), across research teams, (e. g. on the usefulness of viewing progress

in terms of integration of electronic information services into learning), between research teams and the JISC committees (on the significance of particular aspects of observed behavior) and between individual researchers on their interpretation of the data. Silverman (1993) reports rule 2 of qualitative research as avoiding treatment of the actor's point of view as an explanation. It was important to record the students' perceptions, but the researchers were also aware that their accounts were often a 'story' and that explanation required an appreciation of the situation, comparison between student accounts, and checking against accounts from staff. This was less a search for the objective truth than a search for the explanation of the reasons why accounts might differ, or be the same. The later dialogues were concerned with a review of the main questions that had emerged during the research. These included definition of the expected usage and awareness of a particular electronic resource or service (and why), discussion of the effect of different learning and teaching regimes, and the reasons for the difference between the student accounts and what academic staff assumed was happening.

3. The *Information Behavior Model*

This section presents and describes the *Information Behavior Model* that has emerged from the findings of the Framework project. It defines the terms used in the Model. As discussed above all of the data collected and dialogues conducted during the Framework project inform this model. The next section illustrates the evidence that led to the proposal of the model.

The *Information Behavior Model* is shown in Figure 1; this sets out the various micro factors and macro factors that mediate student information behavior.

Insert Figure 1 : The *Information Behavior Model*

Within the *Information Behavior Model* two types of factors are identified:

1. *Micro factors* – those factors that impact directly on specific student information behavior
2. *Macro Factors* – define the context in which information behavior occurs, and may impact on micro factors

Specific factors that impact on student information behavior and which have been identified through analysis of the data collected under the Framework research are:

- *Information literacy* – competencies that students could bring to their learning situation – these may arise from training, previous education, work or life experience. These competencies relate to the retrieval, use, presentation and evaluation of information. In relating these to other models of information literacy, these competencies include the ACRL (2000) skills associated with determining the nature and extent of information needed, accessing information, evaluating information, understanding how to use information effectively, and appreciating the wider economic, social and legal issues.
- *Search strategies* – the type of information seeking routines that students habitually adopt. We make a distinction between Information literacy and search strategies, as the evidence from students often indicated that they knew what they could do, but they did not use the more sophisticated searching techniques. As Järvelin and Ingwersen (2004) note, actors mostly view information seeking and retrieval instrumentally, and want to complete it quickly. Vignettes used in this research and in other studies (Urquhart, 1999) indicate that information seekers can describe a routine strategy for solving an information problem.
- *Academics' information behavior* - the behavior that academics exhibit in relation to information sources, which impacts on students because academics are both role models and mentors in the ways of thinking and practice in the discipline, and set expectations about student information behavior, through the design of learning and assessment. Most research focuses on academics' information seeking for research

and scholarly communication and the role model aspects are implicit rather than explicit. Barry (1997) notes the need for supervisors of doctoral students to have training in electronic information sources as their own skills were often acquired incidentally and were incomplete. Academics' information behavior is influenced by the same factors that affect student information behavior. Academics' information competencies have two distinct strands: competence with subject based information sources; and competence with information technologies.

- *Discipline and curriculum* – the area of study and the way in which knowledge and skills development is structured in a learning experience. Discipline can be specific, such as mathematics, business or pharmacy, or might broadly be grouped into arts, social sciences, and sciences and engineering. There is also an important distinction to be made between vocational and non-vocational disciplines (see Kerins, Madden & Fulton, 2004; Whitmire, 2002)
- *Pedagogy* – the approach adopted by academic staff to teaching and learning. An important aspect is the emphasis placed on problem-based learning or resource-based learning, although this varies according to discipline (see Eskola, 2005). Problem-based learning (PBL) encourages a more active approach to learning by the student, with the teacher acting more as a facilitator, and often associated with professional learning. As the approach emphasizes students' independent information seeking, library services have a greater role in supporting PBL than traditional teaching (Newman, 2003).
- *Support and training* – the formal training or support offered to students to develop and advance their information behavior, mostly provided through LIS staff, or academic staff working with LIS staff. The Big Blue project (2002) discusses the range of delivery methods that may be used in training, noting increasing support for the idea of integrating information skills training into the curriculum

- *Information resource design* – the design, structure and level of the resources that are made available by publishers. The main questions concerns the fit with student learning needs. Some of these aspects are included in the IMS Learning Resource metadata model (2001) for learning objects and include: the type of software required (multimedia resources); the interactivity offered; the degree of difficulty; and, the intended audience. Other factors may be the visual impact, use of graphics, and variations in the packaging, as well as the structuring and navigation options.
- *Information and learning technology infrastructure* – this includes workstation locations and availability, networking arrangements, and the learning management systems or managed or virtual learning environments. An important issue is the interoperability of the systems, such as the links between student record systems and learning management systems, the means of on-campus and off-campus access, and the extent of the networked access (including wireless networks), and the availability of computers within teaching rooms and student residences.
- *Availability and constraints to access* – are related to the information and learning technology infrastructure, but are concerned more with the management of access, such as authentication. The organization of the teaching may encourage students to use resources within timetabled teaching time, or expect students to access resources outside contact teaching time.
- *Organizational leadership and culture* – leadership in relation to the development of a learning culture that prioritizes the development of information behavior in students. The leadership requires willingness to commit to human and material resources that will ‘make this happen’, to increase the capability of the organization.
- *Policies and funding* – at sector level and relating to issues such as learning, the knowledge economy, information literacy, and student-centred learning. Such policies may be at institutional level, or at regional or national level. Universities have a role to play in sustaining the local and national economy. Policies may recognize

how universities should align themselves with business, spawn new enterprises, and produce graduates with the skills required by organizations to compete internationally.

4. Micro factors

This section presents illustrative evidence from the Framework findings to support the inclusion of each of the micro factors identified in the model: information literacy, search strategies, academic's information behavior, discipline and curriculum, pedagogy, and support and training. Micro factors are those factors that impact directly on student information behaviors.

4.1 Information literacy

Information literacy, the operational knowledge of what to do, and why, may often be practiced unconsciously. Attitudes towards what made for a successful search, or not, gave some clues on the skills that are being practiced. Dissatisfaction was associated with unsuccessful searches, but students tended to expect immediate gratification.

'I must have spend about four hours...I was able to find a lot of pictures and diagrams...Four (satisfied score), not five (very satisfied score) only on account of spending time on it.'

Satisfaction might be enhanced by finding something of value that had not been expected.

'it was two hours well spent...there was loads of information...they had looked into the fractal imagery...so that was really quite in-depth research that I had no idea about.'

Satisfaction is largely instrumentalist, and few students reflected on the process of information seeking as learning, as there was little apparent incentive for them to do so. The more experienced searchers among the undergraduates often reflected on the efficiency of their skills in quickly finding something relevant, but not too much.

'And so I used, there's an Internet search engine called Scirus.com...it's very good at finding journal articles and it kind of sorts out things that are not relevant and just leaves you with a decent set of data.'

'Like sometimes you'd put in something in and get like 1000 and something, you look through the first 20 and you think OK, I'm not going to look through that...but if you find the right term you tend to come up with about 30 which is a good number.'

4. 2 Search strategies

Unsurprisingly, the five cycles (1999-2004) witnessed the growing predominance of the use of the Google search engine among undergraduates, as well as the growth of mobile communications. In interviews, six students (under 10% of students interviewed) mentioned Google (*'this Google and it's incredible'*) in 1999/2000. By 2004, the most widely used search engine was Google, and the most popular electronic information services were mobile phones and texting, reflecting the growth in mobile communications. On the other hand, students also used print textbooks (often their own), and vignettes showed that very few students would only use the Internet to resolve a routine study problem.

'I'd probably start with a textbook first...because it's quick, easy, gives me some basic information to start with. It might help me too, if I want some research or something on the Internet getting into a book first gives me some ideas, keywords to put in.'

A less obvious trend was the increasing use students were making of specific organizational sites in their searching in the later cycles.

First year undergraduates indicated that the route they chose to finding information was governed by time factors, convenience of format and an unwillingness to try the unfamiliar unless this was an explicit expectation.

'Well, because I got enough there I didn't bother looking anywhere else. I was pretty tight for time as well so...'

'Well, using textbooks and things, I still had to do that because it's required as part of the project.'

Undergraduates who had progressed beyond the first year were more likely to mention some other quality criteria, such as currency of information, the reliability of the source, and the authority of the source, but time saving was important for them too.

'I could probably use the Internet to ask companies about what trials they use, but for clinical trials and journals – so that it's not one sided, it's better to use MEDLINE'

'But you know the online information is easy to find, a lot quicker as well, and probably more recent as well.'

Selling specialist resources such as the bibliographic databases is not easy, although the students who master the arts of these very strange search engines learn to appreciate the benefits.

'If I hadn't known about the ATHENS thing I would have just gone on...the good things about that is you can actually type in like key words and find it...my essays have been sort of better and I've got more data.'

'Could have used other search engines such as BIOSIS or...the advantage of OVID it's relatively straightforward to use and it's got so many search engines involved.'

4.3 Academics' role in changing information behavior

The research from both teams confirmed how important tutor input was in determining whether students used the electronic information services available to them or not. Apart from habit, the main influence on student choice of electronic information services was tutor expectations – and these could be implicit (an impression given that Web resources were not as 'proper' as paper based resources) or explicit (recommendations and instructions on using specific resources or specific assessment requirements).

'I used the journals because we get told quite a lot that you know the third year level we should be using journals rather than books because it's more recent. And you're getting direct research instead of someone's interpretation of it.'

'The tutors are good as they actually give you lots of Web sites. I have got a Unit...and there is not a lot of literature around for that, so they will always give in the lectures a Web site – go to [name] and that will always give you the latest information.'

4.4 Discipline and curriculum

Disciplinary differences matter (Kling & McKim, 2000) but it is important to recognize that these are often closely linked with the type of learning and teaching strategies found in the discipline.

Aggregating questionnaire data from universities (JUSTEIS) over five cycles showed that there were disciplinary differences in the use of electronic journals (chi-square =77.8, 4 dof, $p < 0.01$). (Table 1) with significantly greater use among students in the clinical disciplines.

Table 1 : Disciplinary differences in levels of use of electronic journals by undergraduates 1999-2004

	Pure and Applied Sciences	Math, Engineering	Pure and Applied Social Sciences	Humanities and Arts	Clinical Medicine	Totals
Electronic journals used	90	48	37	25	93	293
No electronic journal use	277	197	350	199	178	1201
Totals	367	245	387	224	271	1494

Some students were aware of the ways of thinking in their discipline, while others, doing joint honors degrees noted the problems of coping with two different literatures.

'The actual essay was about land registration, so that's the obvious place to start searching, keywords, but there is also legislation...I always tend to start off a very wide search and go through the bits and discard the bits I don't want...obviously we have been shown how to use the various sites, to get the best out of them... but the actual strategy...that's all formulated over a period of time, you get to think how the person who gets to put the keywords together, how are they thinking...you have to think legally and not sort of general English.'

I haven't had a formal training there, I think they assume that if you've had it one side then you understand how to use it the other, which you don't because it's a completely different search engine of course and it's different journals to access and different codes.'

4.5 Pedagogy

There was a different culture evident in further education colleges, and this affected many aspects of the research. Practically, the research was easier to conduct in most further education colleges, as the tutors were interested in how they might use the new facilities offered through the network. The teaching of information skills was part of the national Key Skills framework. Although there are advantages to a national approach, with recognizable standards, adaptations were often necessary to make the skills relevant to the students. The greater amount of class contact time made it easier for tutors to help individual students, or for library staff to help in resource-based learning sessions (similar in aims to problem-based learning).

'We had to go and research into fashions, we had to find images to use for the next lesson...we all went around her [tutor's] main computer...our lessons are an hour and 45 minutes and sometimes we spend over half a lesson just researching'

In higher education, the main influences were evidence-based practice, and the skills of critical appraisal to be inculcated by staff.

'...not giving as much information and knowledge, it's more about giving the skills to acquire and seek information...and also as a professional you've got to be able to filter that information and be critical about it.'

4.6 Support and training.

The interviews illustrated the difficulties of encouraging students to recall the type of training and induction library services may have offered them. There is little firm evidence for the effectiveness of information skills training on long-term student use of electronic information services or their learning, but the cumulated data (from JUSTEIS) over five cycles indicated that joint working by academic and library staff, in training activities, had a statistically significant effect (chi-square = 13.5, 1 dof, $p < 0.01$) in increasing e-journal use and awareness among students (Table 2). Calculations showed that training by library staff alone did not have a statistically significant effect on increasing electronic journal usage, and the indications were that training by academic staff alone had a statistically significant effect in decreasing uptake, a rather puzzling result.

Table 2: Effect of library input into training on use of electronic journals by undergraduates

	Training with input from library staff (joint training)	Training with no library input	Totals
Electronic journals used	192	15	207
Electronic journals not used	474	108	582
	666	123	789

Some disciplines make more use of electronic journals than others, students may 'happen on' electronic journals in general browsing, and the statistical analysis was based on the questionnaire responses only. Interviews revealed that students sometimes needed some encouragement to recall the training and support they had received, and their ways of describing electronic resources, or training programs are not always the same as those used by librarians and academic staff.

5. Macro factors

This section moves on to present evidence in support of inclusion of each of the macro factors in the model: information resource design, information and learning technology infrastructure, access, organizational leadership and culture, policies and funding. Macro factors are those factors at institutional level that define the context in which information behavior occurs.

5.1 Information resource design

One of the differences between the higher education and further education sector was the lack of specialized resources that were suitable for further education students, who are a very diverse group, often with distinct learning needs. Action research in 2001/2002 noted a lack of suitable electronic information at half the sites studied. As one student noted:

'I'm looking for a very specific level of understanding. I don't want too basic, but I don't want to go into huge amounts of detail, so I'm actually looking for a bit more than ...what she's already taught us, but it doesn't go so complicated that I keep having, researching, to understand what I'm finding'

The resources available were often insufficiently comprehensive, and often, as a librarian noted:

'Databases operate in different and difficult ways...Some journals do not want to put their information on Infotrac. It's a big problem...Well, we hardly ever see students having initiated their own use of something like Infotrac.'

5.2 Information and learning technology infrastructure

Managing learning is important for both student and tutor. The JISC became responsible for fostering the development of learning management systems (Virtual learning environments) shortly before the Framework activities started. In 1999/2000 some instances of individual, usually in-house developments were identified, alongside the departmental or individual academic's website. By 2004 these were installed in many more universities, although the

practices varied. The question that emerged in 2001 for the research team was the possible reason or reasons for the limited take-up of such systems. The functionality was not being exploited, and in many departments the usage was essentially no different from the use made of a departmental Web site, although the investment costs considerably greater. More in-depth qualitative analysis in 2002 (Urquhart et al., 2004) comparing the theoretical pedagogical frameworks appropriate for learning management systems with the evidence of how they were used helped to understand what was happening. Students liked the fact that learning materials and the Powerpoint slides were available to them if they had missed the class session, or needed a reminder. Staff were anxious about the impact on their teaching, and the supposed 'added value' of the face to face teaching session, but appreciated some time saving in time spent copying.

'I put lecture notes on there...it's just for them to print out if they want to because it saves us a lot of photocopying.'

'I put all the course notes on the Web,,,and then after I've done my lectures I put my lectures online...I didn't tell them I was going to because I was worried they wouldn't turn up for the lectures.'

The analysis showed that students enjoyed the interactive learning activities on VLEs, and the main advantage for them was the individualisation of learning that was possible, allowing them to learn at their own speed. They also were aware of the misgivings of some academic staff on the advantages of the VLE

'There's a Web site for our biomechanics modules which is extremely good and it has moving parts and stuff like that...And it's brilliant like a book online really...you can see how the limbs interact with each other.'

'Yes it comes up with wee exercises every now and again and gives you the basic principles and tests you on them.'

'I think....if they put everybody's lecture notes on, nobody'd bother going to the lectures too, they've got their ploys somehow.'

5.3 Access

Much is written about e-learning providing 'chunks of learning' or 'bytes of learning', and while some of this may exaggerate the market need, students interviewed, particularly those juggling family, work and study, did see the advantages of such learning.

'And I do enough walking and running around. I don't have to do any more with two kids, I also so some admin work here so, you know I might be checking my work emails and then I might think, oh well, I've got twenty minutes free, I'll just, it's so much easier when you have access to the Internet to look up what you need.'

Home based access to networked resources was a huge advantage for many students, particularly when there was heavy demand for campus resources. Over the five years of the Framework student satisfaction with access generally increased (the percentage dissatisfied with the number of access points was just over 30% in 1999, and just over 20% in 2004, the percentage satisfied was just over 30% in 1999, and over 50% in 2004).

5.4 Organizational leadership and culture

Higher education institutions in the UK vary considerably in size and mission as do their counterparts elsewhere. Researchers are by nature curious, and institutions and departments with a research active culture might be expected to foster greater interest in information seeking among their students, at undergraduate as well as at postgraduate level, even if that influence was implicit, rather than explicit. However, the type of discipline will affect the type of 'ideal' information seeking behaviour to be expected, and the way of knowing may also influence the type of teaching and learning that will be adopted. It is a complex mix. Further data mining has shown that in later cycles more departments did have an agreed learning strategy that affected their expectations of students' use of information resources.

'I think the environment has already created 'this is how you learn'...it takes that big shift, and once that shift is made and everything is much easier, and luckily we've already built up that culture.'

Successful leadership for library staff was `more about influencing inside and outside the library:

'I'm not actually involved in the decision making but I contribute my views. My line manager is the ILT (information and learning technology) and curriculum managers so it comes within his remit.'

'There's a far greater liaison effort that's needed now, not just with the subject teams, but also with the providers...as well with the systems team...the core of our effort is keeping the systems team in touch and chivvyng them along...There's also the whole aspect of needing to take on the extra skills to deal with these things.'

5.5 Policies and funding

The further education colleges gained access to networked resources during the research, and the impact of changing policies and funding was noticeable.

'It's the sort of thing you would expect with generally warm words about resourcing and providing access but as far as e-learning is concerned, it hasn't come yet....I know senior management were looking at it about a year ago, but I think the price has put them off, so it hasn't really been taken anywhere yet.'

Around 2003 the open access discussions started among several organizations. On reviewing previous comments by senior library managers in universities it was interesting to note that few had thought they had much responsibility for the 'tragedy of the commons' (Davis, 2003) in scholarly publishing.

In 2000/2001 a senior library manager commented:

'I was really very amused by this (page charges), I have heard that suggestion from a senior executive of one of the major publishers...It's an interesting idea if it was an attempt to reduce output, because I think it might have that impact. I don't think it's particularly sound.'

By 2004, views had changed.

'This is obviously a very big issue at the moment the whole open archive pre-print area and all that sort of thing.'

Over the five years the main concerns for senior managers were the same, budgeting for increasing costs of electronic information services. Consortia dealings have helped some institutions but by 2004 there were more comments about the problematic trade-offs between content and cost of long-term deals. Planning tended to be opportunistic, and ad-hoc.

6. Review and Discussion of Evidence

This section revisits the themes in the literature review in Part 1 of this paper, with a view to offering a brief summary of some of the key pointer that emerge from the evidence gathered in the Framework. There are a number of areas in which the work in the Framework confirms other work, and thereby provides evidence that these conclusions are generalizable. The Framework research also revealed some findings that have not been evident in previous research.

Student searching strategies

Framework research confirmed other findings relating to undergraduate preference for easy and convenient methods of information searching, and their propensity to use simple search strategies, and search engines (Becker, 2003; Dalglish & Hall, 2000; Drabenstott, 2003; Given, 2002; Liu & Yang, 2004; Valentine, 1993) Specifically, the Framework research noted the growth in the dominance of Google over the five years of the study. The Framework research also offers confirms that student search tactics develop with domain knowledge (Sihvonen & Vakkari, 2004; Wildemuth, 2004; Zhang, Anghelescu & Yuan, 2005). This research noted that, in particular, there was an increase in the use of specialist sources such as bibliographic databases and a development of notions of quality criteria, but this was not uniform across all disciplines.

A key outcome of improved information literacy appeared to be a growing awareness of what made a successful search. More experienced searchers judged the success of their searches on the efficiency of their ability to quickly find something relevant. This student centered search satisfaction perspective should inform work on information literacy.

Pedagogy and academic staff behavior

The Framework research surfaced the very important role of tutors in influencing student information behavior, particularly at the level of simple specific actions such as recommending web sites or insisting that journal sources inform assignments. This evidence adds strength to the findings of the EPIC study which identified tutor influence, but with a group from a more limited range of disciplines.

Previous work on academic's influence on student information behavior tends to focus on the role of pedagogy (e.g. Entwistle, 2003; Eskola, 1999, 2005; Martin, 2003). The Framework research showed that implicit expectations were also very important. Some students managed to interpret the messages correctly, others ignored them or were confused by different messages coming from staff.

Discipline

Ways of knowing, attitudes to knowledge and pedagogical preferences vary between disciplines (Friedlander, 2002; Given, 2002; Healy, Dagar & Wilkie, 2002; Liu & Yang, 2004; Talja & Maula, 2003; Whitmore, 2002,2003). The Framework research showed that this led to different levels of use of e-journals between different discipline groupings, and indicated the need for promotion of electronic resources to be tailored to the needs of particular disciplinary groups.

Library support and training

Although there is commitment to library training and support for the use of digital information sources the evaluation of the impact of that training has proved problematic (Brettle, 2003, Colvin & Keene, 2004,). The Framework research found that the training conducted jointly by academic and library staff had a more significant impact on e-journal usage than training conducted by either library or academic staff alone.

Macro Factors

There is very little evidence of study of the impact of macro factors. Indeed, any study that focused on information behavior in one university or organizational context may not reveal such factors as being of significance because most would be constant. However, they are important in the interpretation of sector-wide studies. These are:

Information Resource Design – the importance of information resources being designed to suit the level of study was most evident at college level, but is also important in university learning.

Information and learning technology infrastructure – the most important aspect of this is that platforms are evolving over time. Over the last five years there has been an increase in the use of virtual learning environments to support learning through digital learning objects and to direct students to other digital resources

Access – Access to networked resources can not be taken for granted; there remain many countries and communities in the world for whom lack of access to a significant barrier to digital information resources. In more privileged communities students value convenient access, such as the opportunity to access university licensed digital resources from home.

Organizational leadership and culture – Senior management commitment to the importance of e-learning for students can impact on commitment at other levels in the organization, affecting factors such as resource allocation to provide good access and training, and the commitment of teaching and learning support staff to promoting access to e-learning and digital information resources

Policies and funding – Policies and funding at sectoral, state, or national level may provide opportunities that increase levels of access or the provision of information literacy programs.

7. Conclusions and Recommendations for Further Research

Part 1 of this paper reviewed the research on the information behavior in the context of digital or electronic information resources. There has been a significant development in this literature over the past five years, but since much of the work has been conducted in parallel with different groups and in different contexts this work has failed to generate a general model of the factors influencing or impacting on institutional information behavior. By drawing on the data collected in a major UK-wide investigation into information behavior amongst students, and the factors that influence that behavior, this paper has:

- surfaced a model that identifies the factors that influence information behavior.
- defined these factors and provided evidence for the inclusion of each in the model.
- Identified significant specific contributions arising from the Framework project in terms of aspects of information behavior.

The institutional *Information Behavior Model* defines a collection of factors that can be used at two different levels to inform future research:

1. The model can be used to identify and define the scope of subsequent studies in terms of the factors in the model, such as discipline, pedagogy, levels of access, and thereby to position specific research projects in relation to other projects
2. The factors identified in the model can be used as the set of variables to consider in future information behavior research. For example, future research might investigate the relationship between discipline, student level (FE, undergraduate and postgraduate) and information behavior, or the impact on different levels of convenience in relation to the access to digital information resources. As the DeLone and McLean model suggests, the concept of 'net benefits of use' need to be clarified

for student use of electronic information services, particularly when search engines offer a convenient one-stop shop.

In addition, by identifying and defining mediating factors the model also provides a context within which it is possible to explore how sets of factors interact. The evidence presented in sections 4 and 5 of this paper demonstrates that not only do macro factors impact on micro factors, but there are also interactions between specific micro factors. For example, different disciplines have different approaches to knowledge, and this influences their pedagogical preferences; both discipline and pedagogy are interacting in their influence on information behavior. Macro factors and micro factors may interact in interesting ways. For example, good information resource design will tend to increase information literacy, and vice versa. However, the effects of poor information resource design (macro factor) may be tempered by good information and learning technology infrastructure (macro factor), if academic staff can take opportunities of software to develop their own learning materials (academic information behavior and pedagogy micro factors interacting).

There is also scope for further work on information behavior amongst other groups, and in other contexts. This might include extension of the work on groups such as tutors and teachers, doctors, engineers, managers and other professional groups. It might also extend to everyday searching in which there is not necessarily an organizational, or support context within which searching takes place. This might, for example include searching for health or travel information, or the search stage in the consumer decision making process in relation to the acquisition of goods and services via the Internet. Such research might lead to a generalized model of information behavior.

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