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# “I Go Into a Lot of Different Places to Get my Research”: Graduate Students’ Mental Models of Research Tools and Services

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## Abstract

Students have access to a wealth of digital information resources from a wide range of publishers. This paper introduces a preliminary analysis of focus group data that asked graduate students in the U.K. how they used a range of library and non-library tools and services to seek information for class projects. The findings suggest a mental model of graduate student information practice is built on a ‘whatever works’ approach rather than any deep knowledge of technical information seeking practices. This model does not differentiate significantly between different services and tools, and has as its goal getting (retrieving) and using (deploying) information in support of various aspects of student life.

**Keywords:** information services, graduate students, libraries, mental models

**Citation:** Khoo, M., Massam, D., Jones, H. (2015). “I Go Into a Lot of Different Places to Get my Research”: Graduate Students’ Mental Models of Research Tools and Services. In *iConference 2015 Proceedings*.

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**Acknowledgements:** The authors gratefully acknowledge the support of JISC in the UK and IMLS in the U.S.A.

**Research Data:** In case you want to publish research data please contact the editor.

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## 1 Introduction

Students increasingly have access to a wealth of digital information resources from a wide range of publishers. Whereas several decades ago, a search for materials in an academic library might include a catalogue search for books, or citation index search for journal articles, students can now navigate to numerous subscription databases before they begin their search. In this complex information environment, it can be difficult, even for experienced students, to know exactly where to go to find the material they need. Academic libraries are responding to this complexity in various ways. One trend in over the past few years has been to reflect some of the ‘one-stop’ characteristics of internet search engines by adopting so-called ‘discovery’ models of service provision, in which the user is presented with a prominently placed search box that supports searching for books, journal articles, conference papers, magazine and newspaper articles, and other documents (Hoepfner, 2012). Entering a query into a discovery service search box triggers a behind-the-scenes search across a single index abstracted from multiple catalogs and databases, with the results returned as a single ranked set. (Examples of discovery services include Ebsco Discovery (<http://www.ebscohost.com/discovery>), and Proquest Summon (<http://www.proquest.com/products-services/The-Summon-Service.html>).

An important issue that has been noted in some previous reports is that of a convergence in users’ eyes between academic library search tools and internet search engines. These reports suggest that users can make little differentiation between OPACs, digital libraries, internet search engines, and other technologies (Makri et al., 2007), and that they can use internet search engines as benchmarks against which to judge other search technologies (Khoo & Hall, 2012). A recently published study by Asher et al. (2013) suggests that, whichever tool they used, students relied default search settings and had issues with evaluating the results. Given that discovery services can also appear to reduce the distinction between different types of information sources (books, articles, newspapers, reports, etc.), what affect is their adoption having on the way students think about research? Two relevant questions here are:

- What technologies do students use in their research practices?
- How do users understand and interpret these technologies, and how do they distinguish between OPACs, internet search engines, discovery services and other tools?

## 2 Mental models

An understanding of users’ expectations of library services can usefully inform ways in which library services such as discovery services might be designed in the future. For instance, academic library web sites could be designed either to accommodate or to counter expectations that they act like an internet

search engine. A useful general theoretical and methodological approach here is that of mental models, which holds that human views of events in the external world are shaped and guided by internal representations of that external world. Beyond this apparently simple concept, there is a range of different theories of mental models, as well as different terms that can be used interchangeably to describe them, such as conceptual models (Staggers & Norcio, 1993). In general, mental models can be thought of as sets of frames, reference points, understandings, metaphors, etc., which a user brings to their interactions with the world, and which provide a basis for a user to make decisions when interacting with the world. There has been some prior research on users' mental models of libraries and search tools, where studies suggest that users can "[view] the electronic library catalog, abstracting services, digital libraries, and internet search engines as variants on a theme" (Makri et al., 2007), evaluate digital library search engines against internet search engines such as Google (Khoo & Hall, 2012), and view library research guides in different ways (Sinkinson et al., 2012).

The theory of mental models adopted in this paper is drawn from Norman (2013). Norman uses the term mental models (and latterly, conceptual models) to understand how users interact with technology, including computational technologies, from a user-centered design perspective. Both of these approaches are useful and appropriate for studying library web sites. In a recent book, Norman describes a conceptual model as "an explanation, usually highly simplified, of how something works. It doesn't have to be complete or even accurate as long as it is useful." Mental models in turn are "the conceptual models in people's minds that represent their understanding of how things work. Different people may hold different mental models of the same item. Indeed, a single person might have multiple models of the same item, each dealing with different aspects of its operation: the models can even be in conflict" (p. 25). Users' mental models can be accurate or inaccurate, and complete or incomplete, depending on users' experience with a technology, and can shape users' interactions with a technology in positive or negative ways.

Norman's model includes a *designer's model* – "The designer's conception of the look, feel and operation of a product" – a *system image* – "what can be derived from the physical structure that has been built (including documentation)" – and the user's *mental model*, "developed through interaction with the product and the system image." The system image should help users to interpret the system design in useful ways. In a well designed system, the system image should reflect the designer's model in such a way as to encourage users to develop useful and accurate mental models of the system in question.

### 3 Data collection and analysis

An important issue in eliciting users' mental models of library discovery systems is that when talking about the ways in which they use libraries, users often do not use technical terms, such as *database*, *catalog*, *index*, *interlibrary loan*, *periodical/serial*, *reference*, *resource*, etc. (Kupersmith, 2012). As a consequence, mental models of libraries need to be inferred from non-technical discourse. In previous studies, this has been done by discourse analysis of interview transcripts (Makri et al., 2007), discourse analysis of documents (Khoo & Hall, 2012), card sorts (Faiks & Hyland, 2000; Sinkinson et al., 2012), co-discovery sessions (Rieh et al., 2010), and a mixture of surveys, interviews, drawing tasks and search tasks (Zhang, 2008).

This analysis in this initial study focuses on transcripts of four focus groups of graduate Social Science and Humanities (SSH) students held on the campus of a university in the U.K. (Table 1). The focus groups were not held at either of the authors' home institutions, but were facilitated by a third party research group. The overall aim of the focus groups was to gather data on types of innovative search and browse interfaces that users might want in future digital libraries. Each focus group included a demonstration of a prototype search and browse tool. All the focus groups followed the same instrument, and were conducted as semi-structured discussions, with additional questions introduced depending on participants' responses. The focus group instrument was created iteratively between researchers in the U.K. and the U.S.A., and the focus group facilitators (Appendix A provides a copy of this instrument).

Table 1: Summary of focus group composition and data analysis

Program	Subjects	Recorded time	Words transcribed	Subjects' words selected for analysis
Masters	7	1:13:00	14,462	6,022
Ph.D.	9	1:17:00	12,432	6,397
Masters	7	0:56:00	9,592	3,694
Ph.D.	8	1:22:00	14,390	7,810
	<b>31</b>	<b>4:48:00</b>	<b>50,876</b>	<b>23,923</b>

The focus groups were recorded and the recordings anonymously transcribed. In this analysis, only the first part of each transcript was used, in which subjects were asked about their existing research strategies, and how they found and used material online (see Instrument in Appendix A). The transcripts were cleaned for further analysis, for instance by removing special characters ('curly quotes,' ellipses ...), speaker markup, and transcriber notes. The resulting documents were saved as two text files, the first containing the Masters students' discourse from focus groups 1 and 3, and the second containing the Ph.D. students' discourse from focus groups 2 and 4. These two text files contained a total of 23,923 words.

The initial text file analysis was carried out by the lead author using *NVivo 10 for Mac* ([http://www.qsrinternational.com/products\\_nvivo-mac.aspx](http://www.qsrinternational.com/products_nvivo-mac.aspx)) and *AntConc* (<http://www.laurenceanthony.net/software.html>). The results were discussed in telephone calls with the team members in the UK. The aim was to identify commonly occurring words, and the contexts in which they were used, in order to identify general themes that could be taken as markers of elements of student mental models of search and discovery tools in academic libraries. *NVivo 10 for Mac* was used to generate frequency counts for each text file. It was used because of the built-in editable stop lists, and the ability to apply stemming. Appendix B provides lists of the top thirty terms used overall by the M.A. students and by the Ph.D. students respectively; note that the distribution is a 'long tail' distribution, with a few terms occurring relatively frequently, and many terms occurring infrequently. These frequency counts were then used to generate 'keyword in context' (KWIC) lists using *AntConc*, a free concordance software tool. Third, the KWIC lists were then used to re-examine and markup the focus group transcripts in *NVivo*.

#### 4 Initial findings

A number of initial analytical themes were identified in the focus group data. Two interesting overlapping themes were as follows:

- Students use non-technical language to describe their interactions with discovery services. describing library and internet search services in ways that gloss over the differences between these technologies; and
- Discovery services, and associated tools and practices, are embedded within a wider series of tools, services and tasks that blur into each other in students' accounts.

A common characteristic across the focus groups was the frequent use by students of non-technical terms to describe various aspects of their information behavior. One such non-technical term that featured prominently in the transcripts was 'use' (use, used, useful, useless, using), which students employed to describe interactions with different tools, including discovery services, as well as Google, Google scholar, Wikipedia, and others:

**I use both**, I guess, but for academic research primarily Scholar, but I guess for a first look on a topic I'd **use Google** and then I'd probably be redirected to Wikipedia [M.A. student]

**I use Wikipedia** quite a lot as a, not to reference, we've always been told that we can't reference Wikipedia. [M.A. student]

I think I do just tend to really **use the library catalogue** because it does take you to a different places like within it, but **it's not like too bad to use really**. I like that it's quite central but it covers like a broad range of sources. [M.A. student]

you find someone that's done something even remotely related to what you're looking at and then **use their bibliography**, because they've essentially done a lot of the work for you compiling that [M.A. student]

Yeah, **I use Google Scholar** as well, just because **I find it quite straightforward to use**. [Ph.D. student]

you do need to use clinical research and then **I wouldn't use Google, I'd use PubMed**. [Ph.D. student]

A second frequent example was the verb 'to get,' which described multiple aspects of searching and retrieving information. 'Getting' seems to be something that students do as part of a broader workflow involving assignments, courses, and student life in general; and 'getting' often described one or more of a sequence of sub-tasks within this workflow, such as acquiring documents:

so if you searched, like, Miller 99 in the Scholar, and then there's a PDF from the University of Texas, click that **and you get a PDF**, it's pretty nice, it's good ... [M.A. student]

And I think sometimes **you get articles on Google Scholar** very easily, instead of putting the details in [inaudible], you can get it directly from Google Scholar. [Ph.D. student]

'Get' was also used to describe accessing databases, as well as lack of access:

Yeah, because the annoying thing is, if you go through the library [databases] ... I could do a quick search or something like that, the dreaded moment where you come across an online article which your institution doesn't have a subscription to or access to, and then you're confronted with the dilemma, do I bother paying for it, do I bother ordering it in some other way, or do I just stick to the ones that [my library] subscribes to and **I can get it straightaway**. [Ph.D. student]

So another issue I have with the library catalogue is that when you find a link to an article on there, it doesn't take you directly to the article, it takes you to the journal, then you've got to sort through it and you've got to sign in, but if you research on Google Scholar, it takes you directly to the page where **you can get the article**, the only real thing you have to after that is just sign in, in which case, as soon as you've done that it just takes me back to it and it's, yeah, bish, bash, bosh. [M.A. student]

Students also 'got' papers from organizational sources:

I also look for the websites of the international development organisations because my topic is relevant to the international development, so UNDP, UNO, Unicef, [inaudible]. I look for their publications on their websites, they are very helpful. **Sometimes you get the books in a PDF format**. [Ph.D. student]

Students used 'get' in a variety of contexts not just confined to the library. One M.A. student, for example, referred to 'getting research' in general:

I get, I go into a lot of different places **to get my research**. [M.A. student]

Overall, students *used* a range of artifacts and spaces, such as libraries, computer clusters, books, and journals, bibliographies, indexes, referencing software (EndNote, Zotero, etc.) in order to *get* things (articles, database access, etc.) mentioned above.

## 5 Discussion: Mental models of tools *versus* mental models of tasks and practices?

One way in which the students articulated their information-seeking tasks was in terms of getting useful resources, with 'useful' often defined contextually as useful in relation to the task-at-hand. The task-at-hand was in turn often situated within the wider goals of student life, such as doing research, completing an assignment, and being at university. From this perspective, the students in the focus groups often did not really have specific mental models of discovery services as such, and particularly not of the technical underpinnings of such tools. However, they did have broader mental models of student assignments as tasks, and of the tools generally available to help them accomplish this task (including the university's discovery system).

At the same time, their understanding of the university discovery system was not uniform; while some students articulated an understanding of the basic 'one stop shop' interaction model of discovery services, such a 'one stop shop' model was often referred to in passing. It was often compared to Google tools and particularly Google Scholar, although no real explanation was ever offered for how these Google tools might work (c.f. Khoo & Hall, 2012). One interpretation of the analysis so far, therefore, is that the student's mental models of information services were often embedded within and informed by wider contexts of their student careers, classroom assignments, and university life, and with making progress in these wider contexts. In this perspective, information services are associated with the (hopefully quick and expedient) gathering of information resources that are useful to the task at hand.

While it is important to note that the students frequently used nontechnical vocabulary in the focus groups, this does not mean that they are naïve users of discovery services, nor are they unsophisticated researchers, but rather that their descriptions of them do not coincide with the technical definitions or descriptions that a vendor or a librarian might provide. In many ways, the students' statements suggest pragmatic and utilitarian approaches to information seeking, with these terms being used here in an everyday rather than any philosophical sense (c.f. Zhang, 2008). In many ways, the students expressed a

preference for immediacy and convenience (c.f. Connaway & Radford, 2011), and often did not discuss any specific technical expertise (for example in terms of queries, search configurations, databases, retrieval, etc.). This observation echoes findings from some of the studies cited above regarding the ways in which students pick whatever tool seems to work for them (e.g. Makri, et al., 2007; Khoo & Hall, 2012), and raises further questions regarding how and why students engage with and use discovery tools. From the perspective of Norman's mental model approach, it suggests that there are a number of avenues to explore with regard to the design of system images and interfaces that can further support students to discovery tools in more efficient ways. These themes, and their implications for information literacy and tool design, will be explored in further analyses.

## Conclusion.

Students have access to a wealth of digital information resources from a wide range of publishers. In academic libraries, these resources are increasingly integrated into 'one shop shop' discovery services. To support better understanding of the ways in which students use these services, transcripts of four focus group sessions with graduate students in the UK were analyzed, using a framework based on mental models. Several elements of a graduate student mental model of discovery services were identified, including the concepts of 'getting' and 'using,' and a lack of differentiation between different services. The findings suggest graduate student information seeking practices are often seen as a means to an end within the wider context of student careers, and the 'getting' and 'using' information in support of various aspects of student life (assignments, classes, earning a degree and graduation, etc.).

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## Appendix A: Facilitators' Guide

[Note for this paper: The focus group data analyzed in this paper was collected mainly in section 3 of the focus group, 'Online Research Practices.' Each focus group also included a section that demonstrated a prototype search and browse tool, and for clarity this part of the protocol is omitted from this Appendix.]

### 1. Background and Introduction

#### 1.1 Facilitator's introduction

- Purpose of the focus groups. Introduce the overall project and explain why we're conducting the focus groups
- Timings and format
- Code of Conduct. Explain confidentiality, what will be done with the information collected, follow-ups etc.
- Observer introductions

#### 1.2 Participant introductions

- Name
- Course/studies/areas of academic interest etc.
- Interests outside of their studies

### 2. Warm-up

The purpose of this part of the discussion is to ensure that group members are comfortable with the focus group format and have started to 'interact' before we tackle more specific issues. We'll keep this as brief as possible, with a broad discussion about how they go about doing their research.

- Time spent doing research
- Frustrations
- When do they do their research
- Skills required
- Devices
- Online research resources

### 3. Online research practices: in-depth discussion

This section aims to expand on the warm-up and find out from respondents how they undertake and think about research (and online research in particular). The moderator will ask each respondent in turn to summarise recent and typical research/search activities. Key areas of focus to be:

- What research did they do?
- Where did they start and why did they start there?
- Where did they go after this and why?
- How successful/satisfactory was the research?
- What worked well? (referring if possible to specific search engines, trusted tools etc.)
- What was less successful? (again, referring to specific search engines, websites, tools etc.)

Discussion will now to be opened up to the whole group. The moderator will probe to ensure a full understanding of how the participants undertake their research. Discussions will be developed to include:

- Shared experiences, frustrations, trusted resources, procedures etc.
- Any solutions to the problems and frustrations raised?
- Favourite/trusted tools; starting points; search engines; aggregator sites etc.
- What do they see as the differences between the tools? Why would they prefer one tool over another?
- Why and in what circumstances do they use these tools?
- How do they think the tools they use work and how do they return the results (use an example of a tool they've mentioned here)?
- Is this important to them when choosing tools/search engines to use?
- What is their understanding of searching and browsing

- How do they organize their research results and keep track of what they retrieve from multiple tools

The last specific focus in this section will be on attitudes, experiences and preferences in relation to:

- Searching across multiple tools information sources
- The importance of serendipity to their research

Discussion prompts include:

- Knowing where to start
- Repeating searches in lots of different databases
- Experience of tools/portals that search across multiple information sources, e.g. Primo/Summons. How does this work for them? Likes/dislikes
- How do they understand what the tool is doing?
- Finding resources they never thought they were looking for – how does this happen online?
- Is this important to them?

#### **4. Specific focus on Project prototypes**

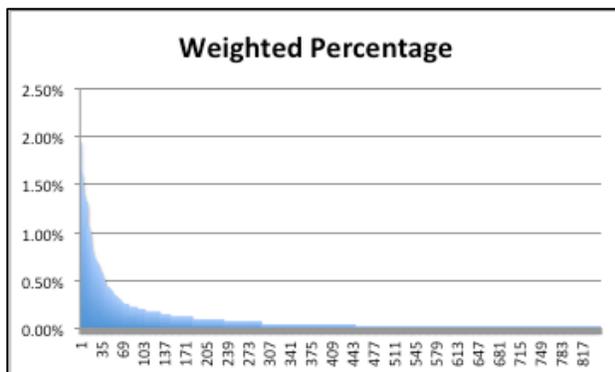
[removed for this paper]

#### **5. Review of discussions and any other issues**

- Review of key points
- Any other issues

**Appendix B: Word frequency counts: Research subjects: M.A. students**

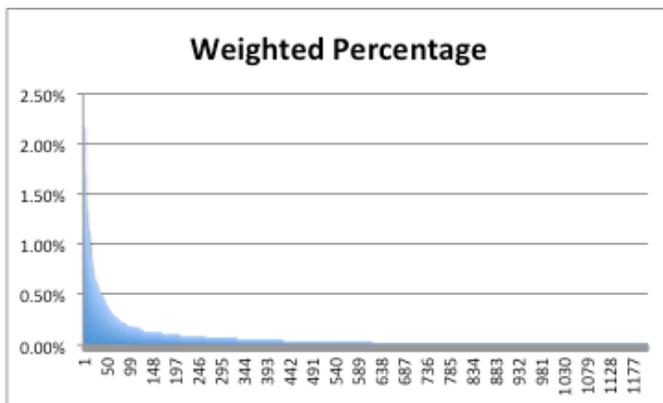
Word	Length	Count	Weighted %	Similar Words
using	5	75	1.94%	use, used, useful, using
things	6	63	1.63%	thing, things
know	4	62	1.60%	know, knowing
think	5	58	1.50%	think
get	3	55	1.42%	get, gets, getting
really	6	54	1.39%	really
got	3	53	1.37%	got
actually	8	52	1.34%	actual, actually
well	4	51	1.32%	well
find	4	51	1.32%	find, finding
article	7	50	1.29%	article, articles
library	7	41	1.06%	libraries, library
read	4	41	1.06%	read, reading, reads
sort	4	41	1.06%	sort, sorted, sorts
one	3	39	1.01%	one, ones
books	5	39	1.01%	book, books
want	4	36	0.93%	want, wanted, wants
search	6	33	0.85%	search, searched, searches, searching
lot	3	33	0.85%	lot, lots
going	5	31	0.80%	going
bit	3	30	0.77%	bit, bits
looking	7	29	0.75%	look, looked, looking, looks
working	7	29	0.75%	work, worked, working, works
research	8	28	0.72%	research, researched, researching
google	6	28	0.72%	google
quite	5	27	0.70%	quite
journal	7	27	0.70%	journal, journals
good	4	26	0.67%	good
year	4	26	0.67%	year, years
put	3	26	0.67%	put, putting



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**Appendix B: Word frequency counts: Research subjects: Ph.D. students**

Word	Length	Count	Weighted %	Similar Words
knows	5	130	2.17%	know, knowing, knows
using	5	102	1.70%	use, used, useful, uses, using
get	3	88	1.47%	get, gets, getting
things	6	82	1.37%	thing, things
one	3	80	1.34%	one, ones
library	7	74	1.24%	libraries, library
books	5	70	1.17%	book, books
searching	9	69	1.15%	search, searched, searches, searching
thinking	8	68	1.14%	think, thinking, thinks
looks	5	65	1.09%	look, looked, looking, looks
well	4	61	1.02%	well
research	8	61	1.02%	research, researcher, researches, researching
really	6	53	0.89%	really
google	6	51	0.85%	google, googled, googling
something	9	49	0.82%	something
put	3	47	0.79%	put, putting
find	4	46	0.77%	find, finding
article	7	43	0.72%	article, articles
way	3	40	0.67%	way, ways
time	4	40	0.67%	time, times
different	9	40	0.67%	difference, different, differently
kind	4	39	0.65%	kind
going	5	38	0.63%	going
year	4	38	0.63%	year, years
journals	8	37	0.62%	journal, journals
want	4	37	0.62%	want, wanted
start	5	36	0.60%	start, started, starting, starts
lot	3	35	0.58%	lot, lots
actually	8	34	0.57%	actually
come	4	33	0.55%	come, comes, coming



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