**Subject Guides and Resource Discovery**

**by**

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# Abstract

*Research problem*

Subject guides are disciplinary resource discovery maps long created by librarians to assist library users in independently locating resources within the library. While best practices in the design and promotion of guides are well documented in the literature, analyses of usage are scant. Furthermore, given developments in resource discovery, including Web-scale discovery tools and Google Scholar, subject guide usage needs to be contextualised in relation to the usage of other discovery tools.

*Methodology*

Access data for the access of subject guides and resource discovery tools located on the University of Canterbury (UC) Library Website was collected for the last five weeks of the first term of the academic year. Subject guide access data was gathered using Google Analytics and resource discovery tool access data was gathered from EZproxy server logs. Access statistics for subject guides (hosted on LibGuides) were analysed to investigate disciplinary differences in subject guide access. To investigate disciplinary differences in resource access behaviour, EZproxy server logs were parsed and analysed to quantify resource access originating from the four main resource discovery tools offered by UC Library: subject guides (as hosted on LibGuides), Web-scale discovery (Summon), databases (via Biblioplus) and Google Scholar.

*Results*

Four disciplinary groups of subject guides were responsible for 82% of all subject guide page views, with the remaining 18 disciplinary groups of guides having relatively low access. When raw access figures were normalised according to student enrolments, subject guides for the Law & Legal Studies, Studies in Human Society, and History & Archaeology disciplines attracted disproportionately high access, while subject guides in Economics, Engineering, and Mathematical Sciences attracted disproportionately low access. Analysing the resource discovery tools used to access sample databases for these disciplines revealed different disciplinary approaches to resource discovery. Disciplines that had high access rates for subject guides were more likely to commence information resource searches in subject guides or a specific database. Disciplines that had low access rates for subject guides were more likely to commence information resource searches in Summon or Google Scholar.

*Implications*

The differences in subject guide usage and resource discovery approaches suggests different disciplinary needs for information resource discovery. Given the low usage for most guides found in this study and the dominance of Summon, in particular, as a resource discovery tool, the creation of subject guides for all disciplines may no longer be an effective method for supporting patrons in resource discovery.


*Keywords:*
Subject guides; resource discovery tools; academic discipline; databases; web-scale discovery; Google Scholar

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# Introduction

Subject guides, also known as pathfinders or research guides, have long been created by academic librarians for students as "both a guide to the resources of a particular library and as the gateway to the wider literature of a subject field" (Harrington, 2008, p. 39). Originally created as print pamphlets listing resources and their location in the library, subject guides are now usually online resources, with links to online resources and search tools as well as lists of print resources. LibGuides, a commercial content management system, is the dominant software used in academic libraries to create subject guides.[1] [2]

## Problem Statement

Academic libraries invest significant resources in making subject guides with, thus far, little evidence of much use. Recent analyses of subject guide usage data have discovered that an unexpected proportion of usage, in one case as much as 70%, was from users unaffiliated with the library (Castro-Gessner, Wilcox, & Chandler, 2013). Furthermore, students have reported preferring other library tools to subject guides (Conerton & Goldenstein, 2017; Costello, Del Bosque, Skarl, & Yunkin, 2015). Subject guides have been redeveloped as online resources in response to the changing expectations of patrons used to navigating a Web 2.0 world, yet the literature does not consider what the rise in a multitude of electronic resource discovery tools might mean for the utility of subject guides. More specifically, it is not clear that patrons still need subject guides to locate appropriate academic resources when alternative tools such as Web-scale discovery and Google Scholar offer convenient one-search box functionality.

## Objective and significance

The objective of this research project is to quantify the usage of subject guides within the context of the range of information resource discovery tools offered by the academic library (e.g., comparing relative use of guides and alternatives) and identify whether there are academic disciplinary differences. This study will contribute to LIS knowledge by providing empirical evidence regarding student use of subject guides, and building on current knowledge regarding the role of subject guides in the academic library information environment.

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[1] Springshare, the company that owns LibGuides software, reports 500,000+ guides in existence (Springshare, n.d.).
[2] Accordingly, in this study, subject guide and LibGuides are used interchangeably, reflecting these terms' usage in the literature.

## Literature review

A large body of literature on subject guides examines various dimensions of their creation, including location (Griffin & Taylor, 2018; Murphy & Black, 2013) and design (Bowen, Ellis, & Chaparro, 2018; Castro-Gessner, Chandler, & Wilcox, 2015; Thorngate & Hoden, 2017). A subset of this literature analyses usage data, on which this review will focus. The usage of subject guides is rarely quantified in the literature beyond vendor-generated usage statistics, nor is usage routinely interrogated to identify who is accessing subject guides. Yet several studies have found that subject guide usage can be attributed as much to an external audience as that of a library's patrons. Furthermore, there are some indications that students prefer other resource discovery tools offered by the library. Technological advances and associated changes in information seeking behaviour invite a reconsideration of subject guides within academic libraries' broader information environment, with attention to potential disciplinary differences in information access behaviour.

A number of studies have drawn on vendor-provided usage statistics to analyse the number of time subject guides are accessed, yet actual usage remains ambiguous. For example, a number of studies fail to contextualise usage statistics with reference to student numbers making it difficult to assess whether the guides are well used (Adebonojo, 2010; Courtois, Higgins, & Kapur, 2005; Dalton & Pan, 2014). One study that did contextualise usage reported Springshare-generated access statistics and uncritically compared them to the Google Analytics data generated for previous non-LibGuides subject guides as evidence of increased usage (Yeo, 2011). This is of concern because page view statistics provided by Springshare can include bot hits, multiple hits from one IP address, and library staff usage, thereby inflating usage statistics (Farney, 2016c; Griffin & Taylor, 2018). Furthermore, these statistics cannot be parsed to identify who is accessing subject guides. Several studies have employed Web analytics to discover that most usage was from unaffiliated users (Campbell, Varnum, & Bertram, 2016; Castro-Gessner et al., 2013).

The prevailing recommendation in the literature is that better design and greater promotion, whether that be through library instruction or locating guides in learning management systems, will lead to greater usage. But a research participant in one study offered a different perspective, stating: "she would not use the guides to answer the types of questions the usability test asked because she already could accomplish many of those tasks by using the library website" (Costello et al., 2015, p. 57). Another study reported that eight of eleven participants said they too would usually use an alternative library tool to complete the usability tasks (Conerton & Goldenstein, 2017). As an earlier qualitative study baldly put it, "participants preferred many resources and search strategies over subject guides, including databases recommended to them, databases that had worked for them in the past, free internet resources, or citation chaining from a known source (Ouellette, 2011, p. 443).

It has been asserted that "librarians need to consider user behaviour and observed use patterns" to inform subject guide creation (Griffin & Taylor, 2018, p. 12). Considering 'observed use patterns' of subject guides in relation to students' broader information context may offer a more fruitful approach to understanding the relevance of subject guides to library patrons.

The issue of whether subject guides have evolved to incorporate technological advances in information management has been conceptualised as the extent to which "Web 2.0 tools have been integrated within subject guides" (Morris & Del Bosque, 2010, p. 179). Early iterations of subject guides routinely included Library of Congress Subject headings and call ranges, relevant reference works, catalogues, classic works on a subject and lists of relevant journal titles (Harrington, 2008). Links to relevant databases and Websites are the resources most frequently included in Libguide-era subject guides, followed by lists of books in the library collections and how-to information (Morris & Del Bosque, 2010). It remain unclear whether subject guides are still necessary given most academic libraries now offer a suite of Web 2.0 resource discovery tools that have significantly streamlined resource discovery. For example, Web-scale discovery (Foster, 2018), library-linked Google Scholar (Asher, Duke, & Wilson, 2013; Dixon, Duncan, Fagan, Mandernach, & Warlick, 2010), and resource links in learning management systems (Cross, 2015; "Reading list product category grows," 2015), are all examples of such tools that have simplified resource discovery.

Convenience and ease-of-use, found to be primary factors in academic information seeking behaviour, are the underlying features of these new tools (Connaway, Dickey, & Radford, 2011; Joo & Choi, 2015).  Convenience is defined as "complete access to resources, beyond merely discovering and identifying them" (Connaway et al., 2011, p. 187).  A range of information discovery tools offering appropriate and easily accessible information sources are available in academic libraries, raising the question: do patrons still need a subject guide to locate relevant information resources? Comparing subject guides with alternative discovery tools, such as Google Scholar and Web-scale discovery tools (see Table 1), indicates the greater convenience and ease-of-use offered by these alternative tools.

**Table 1.** Comparison of the content, function and format of resource discovery tools offered in academic libraries indicate that subject guides are less convenient and not as easy to use as other resource discovery tools.

|  | Subject content | Search Function | Format |
|---|---|---|---|
| **Subject guides** | Subject-specific curated content, including databases, journal titles, books and government documents. | Provide links to databases and resources, that may then need to be searched | Bibliographic information with hyperlinks |
| **Databases/ Indexes** | Collections of subject-specific academic journals. | • Boolean and keyword searching.<br>• Multiple search boxes.<br>• Results can be refined using subject-specific and/or index-specific facets. | • Bibliographic information<br>• Full-text when available. |
| **Web-Scale discovery** | All scholarly content subscribed to by the library | • Boolean and keyword searching.<br>• One search box.<br>• Results can be refined using facets. | • Full-text when available |
| **Google Scholar** | Scrapes scholarly content from across the internet | • Keyword searching.<br>• One search box.<br>• Limited ability to refine results using facets | • Full-text when available if user links library to their Google Scholar account |

The introduction of a Web-scale discovery tool and link resolver led to a 34% decline in queries at the reference desk at one academic library (Copenhaver & Koclanes, 2016), and there is no reason to believe subject guide usage has not also been influenced by the implementation of Web-scale discovery tools. A 2013 study surveyed students to evaluate the impact of the recent adoption of a Web-scale discovery tool on usage of other tools and services offered, including subject guides (Mussell & Croft, 2013). Just 1.7% of respondents named LibGuides as their first port of call when starting research, with alternatives to subject guides, such as Google Scholar and the Web-scale discovery tool, all having higher reported use. When asked to name *all* the resources they used, 7% of respondents named LibGuides, yet 22% reported using the newly introduced Web-scale discovery tool. The limitations of retrospectively self-reporting online behaviour have been covered in the literature (Bergman, Gradovitch, Bar-Ilan, & Beyth-Marom, 2013), and while this study corroborated student reports with brief reference to total usage statistics for each resource discovery tool, there is a need for a comprehensive empirical analysis.

There is also a need to consider whether usage patterns of resource discovery tools, including subject guides, differ across disciplines. Recent quantitative analyses of library use have found disciplinary differences in use of digital resources (Jara et al., 2017; Kim, 2011; Nackerud,

Fransen, Peterson, & Mastel, 2013). Nonetheless, there is little mention of academic discipline in the subject guide literature, beyond an aside from Murphy and Black that "[s]ome academic disciplines, especially in the sciences, rely on a limited set of discovery tools, making the need for a customized library guide less pronounced" (2013, p. 533). Conversely, subject guides with higher usage may be meeting a specific disciplinary resource discovery need unmet by standard resource discovery tools. While studies have reported individual guide usage, a cross-disciplinary analysis is necessary to identify patron needs.

In summation, while there is a wealth of literature investigating best practice regarding the design and location of subject guides, critical engagement with subject guide usage either relies on vendor-generated usage data or fails to contextualise usage statistics with reference to enrolments or academic discipline. As a result, there is currently no consensus on whether patrons are accessing subject guides, or even whether subject guides are meeting a resource discovery need. The rise in one-search box resource discovery tools in academic libraries meets a growing expectation of convenient 'google-like' search interfaces, and may also be supplanting the need for subject guides. Therefore, to identify the value of subject guides to patrons we need to contextualise usage statistics within the broader information environment, including discipline and resource discovery tools.

## Research questions

1. How many page views of subject guides can be attributed to patron use and do page view figures differ across disciplines?

   Sub-questions:

   a)  What proportion of subject guide page views can reasonably be attributed to patrons?

   b)  What are the page view statistics for each subject guide relative to enrolments in that subject?

2. Which resource discovery tools are used most to access electronic resources and does tool access differ across disciplines?

   Sub-questions:

   a)  What proportion of access to electronic resources originates from each of the following resource discovery tools: subject guides; Summon; Google Scholar; database index

   b)  Are there disciplinary differences in the proportion of access originating from the following resource discovery tools:  subject guides; Summon; Google Scholar; database index

## Research design

This research will take a quantitative approach to investigating subject guides usage in one New Zealand academic library. A relational research design is employed to explore subject guide usage, particularly in comparison with usage of the following information resource discovery tools: Web-scale discovery, Google Scholar, and bibliographic/full-text databases.

A quantitative design has been selected because a number of studies report positive student evaluations of subject guides in spite of low usage (Chiware, 2014; Dalton & Pan, 2014; Murphy & Black, 2013; Tomlin, Tewell, Mullins, & Dent, 2017). This indicates the potential for user behaviour to differ from user perception, as was found in a study of personal information management tools (Bergman et al., 2013). The Principle of Least Effort (Case, Given, & Mai, 2016), that is the idea that it is human behaviour to expend the least effort possible to complete a task, could conceivably lead patrons to recognise the value of subject guides yet fail to use them – particularly if other available resource discovery tools are more convenient or easy to use. Understanding why subject guides may be too much effort for many users could be as simple as the number of steps required to locate a guide on the website (as has been found in a broader study of information resource access (Vecchione, Brown, Allen, & Baschnagel, 2016)). It could be as complex as cognitive overload, where a user is overwhelmed by the amount of information and resources provided (Little, 2010).

While the Principle of Least Effort and cognitive load theory seem germane to this investigation of resource discovery tool usage, the reliance on quantitative data means their use would be speculative. It is hoped some of the findings of this research when considered with recent quantitative analyses of subject guide and resource discovery usage (Farney, 2016c; Gonzales, 2018; Griffin & Taylor, 2018; Yeager, 2017) may precipitate future mixed-methods studies to unpack the reasons behind information search behaviour patterns.

## Methodology

### Population and sample
This study will analyse the usage of four electronic resource discovery tools offered by the University of Canterbury (UC) Library:

1. Subject guides hosted on LibGuides software. There are 63 subject guides linked to from the index page on the UC Library website (http://canterbury.libguides.com/?b=s) and usage data from all will be analysed in this study.[3]
2. The Web-scale discovery system Summon (located on the library homepage (www.canterbury.ac.nz/library).
3. Google Scholar, to which the library's collections are linked and can be directly accessed.
4. A comprehensive index of databases supplied via the UC Library website using Biblioplus (https://www.canterbury.ac.nz/library/search-our-collections/databases/).

This study's focus on electronic resources reflects UC Library's collections. In 2017 there were 213,363 print checkouts, compared to 3,493,330 usages of eBooks (2,084,528) and eJournals (1,408,802) (University of Canterbury Library, 2018). This study will gather access data for these four resource discovery tools for the latter five weeks of the first term of Semester One in 2019 (4 March – 7 April 2019). This timeframe has been chosen because the library offers the bulk of its information literacy instruction and conducts the most resource promotion during the first two weeks of Term 1 (18 February – 3 March 2019) and most courses have their first major assignment before the end of the term. Therefore, it is assumed that access data will be representative of student access behaviour outside of formal library instruction.

Data collection, preparation and analysis is described in the following sections. For a summary of the study design, see Table 2.

Data collection

There are two aspects of data collection in this study:

1. *LibGuides access data*

Access data for UC LibGuides was collected from Google Analytics, a method employed in other studies of subject guide usage (Campbell et al., 2016; Griffin & Taylor, 2018). Google Analytics was chosen because the usage data provided by Springshare (the LibGuides vendor) is too ambiguous to provide a useful measure of usage. For example, it is unclear whether bot hits and multiple hits from

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[3] Almost 100 guides in total are linked to from the UC Library website, with other guides including course guides, topic guides (such as Endnote), and general guides (such as guides regarding the information research cycle, finding New Zealand statistics, and theses). This study is interested in the relevance of disciplinary subject guides and thus excludes these other guides from analysis.

one user in one session are included in page view statistics, user engagement metrics are not available, and it is not possible to distinguish between library staff and customer page view statistics (Castro-Gessner et al., 2013; Farney, 2016c). In contrast, Google Analytics data provides unique page view statistics (i.e. "pageviews that are generated by the same user during the same session" are aggregated to convey "the number of sessions during which that page was viewed one or more times" (Google, n.d.)) and can be filtered to exclude specific access groups and bots.

Multiples filters to exclude UC Library staff IP address ranges were applied within Google Analytics prior to the start of term. This removed access statistics from library staff demonstration of subject guides in workshops, consultations and at the reference desk, as well as library staff usage of subject guides to support reference queries. A second filter was applied to exclude all access that originated out of New Zealand. The sizable distance student cohort at UC precludes refining the geographical location of users any further. However, it is assumed that these filters will effectively limit the data to that likely from UC Library patrons.[4]

Access data for all UC subject guides linked to on the UC Library website was downloaded from Google Analytics for 4 March – 7 April 2019 in an Excel spreadsheet. The data downloaded detailed unique page views for each page contained within the subject guides hosted on the UC Library website.

2. *Access data for UC Library electronic resources.*

UC Library uses an EZproxy server to enable access to almost all UC Library electronic resources: on the UC campus, patron usage of a UC IP address automatically enables access via the server; off campus, the EZproxy server requires patrons to enter a UC login to confirm they are staff or students of UC before access is enabled. The EZProxy server mediates access to all electronic resources, whether via a subject guide, Summon, Google Scholar or the database index page. Every hit[5] on an electronic resource is recorded in the EZproxy server creating a rich source of data, and a number of studies have analysed EZproxy data to investigate electronic resource usage (Brown & Smith, 2017; Jara et al., 2017; Nackerud et al., 2013; Samson, 2014; Yeager, 2017). EZproxy data generated between 4 March – 7 April 2019 was downloaded weekly and saved in plain text files.

EZproxy server data was chosen for this portion of the research out of necessity. Farney (2016a, 2016b, 2016c) has detailed a methodology for using Google Analytics to track usage of

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[4] The majority of UC Library patrons are undergraduate students. Other patrons are postgraduate students, academic staff and visitors, and general staff.
[5] A hit is recorded every time a webserver sends a file to a browser. Since a file is sent for every image, widget, graph and so on, and one page may contain many images, widgets and graphs, a hit cannot in itself be considered an indication of one instance of access (Opentracker, n.d.).

discovery services, catalogues, and link resolver tools. However, the current configuration of the library website precludes adding codes to individual databases (e.g. the database index organises databases alphabetically with one webpage for each letter of the alphabet and multiple databases assigned to each page based on their initial).

Data preparation

*1. Google Analytics Data*

The unique view data for each page on the subject guides were sorted into 63 groups, one for each subject guide listed on the UC homepage, as indicated by the title of the page. Because a number of the guides were for specific subjects taught at UC that did not necessarily constitute separate disciplines (e.g., there were 11 subject guides for different branches of engineering), these guides were sorted into one of 22 possible academic disciplines based on *The Australian and New Zealand Standard Research Classification* (ANZSRC) (Pink & Bascand, 2008). Appendix A reproduces the main fields of the ANZSRC classification, and Appendix B details which UC subjects (and subject guides) align with which ANZSRC disciplines.

*2. EZproxy Data*

One of the challenges of using EZproxy server logs is the sheer volume of data created by recording every file sent to a browser. The five weeks of data collected for this project constituted approximately 5 million lines of code across five different files. The data was compiled, formatted and refined using a python script (Angelo, 2019) to create a manageable dataset that included only relevant data, through the following steps:

1. Compiling files into one file
2. Formatting lines of code into standard fields. UC Library uses the following log configuration for their EZproxy server: %h %l %u %t "%r" %s %b "%{referrer]I  which corresponds to the following seven data fields[6]:

    IP address : Username : Date/Time request made : Complete request : Status of request: Number of bytes transferred : The URL user was on prior to requesting EZproxy access (OCLC, 2018).

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[6] %l and %u both correspond to username as users access can be authenticated automatically (%l) and manually (%u).

However, the lines of code include the seven fields in one long string, making the information contained within each line hard to decipher. Each line of code was split into distinct fields.

3. The dataset was refined to include only the fields relevant to the research question:

    IP address : Date of access : Complete request : Status of request:

    The URL user was on prior to requesting EZproxy access

4. The URLs in the fields for Complete Request (i.e. the requested URL) and the URL user was on prior to requesting EZproxy access (i.e. the referring URL) was duplicated and split into five additional fields: URL Domain, URL Host, URL top-level domain, URL path and URL query. While the URL domain was the section of the URL most frequently used to identify the location of the requested and referring URLs, there were some databases (for example, databases hosted on an aggregator platform) where the identifying information was in one of the other fields. In addition, this additional formatting enabled the data to be custom filtered and/or sorted in Excel.

5. Lines of code originating from UC Library staff IP addresses were excluded to ensure the data only captured patron behaviour.

Since this study is only interested how users access electronic resources, not their behaviour once they have accessed a particular resource, the data file needed to be further refined to include only lines of code that capture a patron's first entrance into a database. The data set was further refined as follows:

6. *Retaining only 200-300 HTTP status codes.*
    The status request field in the EZproxy log configuration contains HTTP status codes, which indicate whether a server successfully delivers the requested file. 200-300 http status codes in a line of indicate successful access or a redirection to a different URL to complete the request. Other status codes are purely informational or indicate errors so are not relevant to this project (WebFX, n.d.).

7. *Excluding all lines of code that contained identical URL domains*
    If a line of code had the same URL domain in the request and referrer URL, this indicates the patron is searching within a database and thus this data is not relevant to the question of how patrons were accessing resources.

8. *Excluding all lines of code with a request URL with an irrelevant file format*

Images (e.g., .png, .jpg, .jpeg), computer icons and vector graphics (e.g., .ico, .svg), and webpage formatting files (e.g., .css, .woff) are all examples of files that are sent to a patron's browser when they search any webpage. Any single webpage can contain multiple such files in addition to search information, clogging the dataset with irrelevant information.

9. *Excluding all lines of code with a request URL that linked to an Exam Papers portal on the library website.*

   After discovering that access to an UC Exam Papers archive was being mediated via the EZproxy server, all lines of code requesting information from the archive were deleted.

The dataset now contained approximately 1,430,344 lines. The size of the dataset, combined with the sheer number of databases (346) offered by UC Library, precluded a complete analysis in a project this size. Therefore, for the purposes of this project a sample of 12 databases is analysed: two core databases for three of the mostly highly used subject guides and three of the least frequently used subject guides (based on the analysis of subject guide usage detailed above). Lines of code containing a request for the 12 sample databases were identified by the domain or host field within the Request URL, with data for each database saved in a separate Excel file. A complicating factor in identifying database data was the inclusion in the database sample of databases accessible via one of two aggregator platforms (Ebscohost and ProQuest). These databases cannot be identified by the URL domain or host alone (Brown & Smith, 2017). For these three databases, relevant lines of code were identified by the URL domain (indicating the platform) in conjunction with the relevant database codes appearing in the URL Path (Proquest) or URL Query (EBSCOhost).

Another consideration in preparing the data was the potential for very frequent library users to skew the results. Analysis of the frequency of IP addresses revealed that there was indeed a wide range in frequency, with some IP addresses recurring at rates of up to 100 times the average. For this reason, once the data was refined down to lines of codes for each of the sample disciplines, confidence intervals were calculated for IP address frequency in the dataset to identify unusually frequent users. IP addresses that occurred in the dataset at a frequency either less than the lower bound value or higher than the upper bound value (these differed for each discipline) were removed from the data set to ensure that the picture of resource discovery generated from the data reflected typical patron behaviour.

It became apparent during preliminary analyses of the EZproxy data that further refinement of the data was required:

1. *Many lines of code captured inter-database resource discovery via UC Library's link resolver.*

   Intra-databases access had been excluded by deleting lines of code with identical domains in the request and referrer URL fields, but a large number of lines of code contained markers in the request and referrer URL fields for two different databases.  Usually these markers were the URL domain, but for databases accessible via aggregators the marker was in the referrer URL query field. Patrons were clicking on DOIs/URLs in reference lists or indexes in one database and being redirected to a second database. These lines of code were manually identified and excluded from each disciplinary dataset.

2. *The programmed inclusion of 300 HTTP status codes was artificially inflating the data.*

   300 status codes are redirects, a very common means of directing library patrons' information requests from a resource discovery tool to the relevant databases and it had been assumed these represented additional successful access. Close analysis of HTTP status codes in conjunction with IP address and timestamp revealed that referrals from subject guides, the database index and Google Scholar featured 2-3 lines of code with identical IP addresses, request and referrer URLs and date-stamps spanning 2-3 seconds. The first 1-2 lines of code had 301 or 302 HTTP status codes before a final line with a 200 'success' status code. Hence, what could realistically only be counted as one access was being counted as three accesses if 300 codes were retained. Therefore, lines of data with 300 HTTP status codes and referrals from subject guides, the database index or Google Scholar were removed from the data set to avoid artificially inflating access counts.

   Analysis of the HTTP status codes for referrals from Summon revealed a more idiosyncratic pattern of access. While many referrals involved 2-3 lines of code, a number of single lines of code indicating referral from Summon to a database contained 301 and/or 302 HTTP status codes. There was no discernible pattern, other than that the proportion of redirects varied between databases. Excluding 300 redirects from Summon referral data would distort rather than clarify access counts. For example, the exclusion of 300 status codes from the data set for Studies in Human Society databases would exclude 9.4% of legitimate access data for Summon referrals. Therefore, the Summon referral data for each disciplinary dataset was manually reviewed. Any line of code with a 301 or 302 HTTP status code was deleted if it met the following criteria:

   a. It was one in a group of lines of code generated within 3 seconds that had
      - Identical IP addresses
      - Identical request URL domains

- Identical referrer URL domains

- Virtually identical request queries

- Identical referrer URL queries

b.   One line in the group had a 200 HTTP status code.

Finally, there was one database for which every line of code in the dataset was a 301 redirect. This suggests a recently URL change (WebFX, n.d.). In addition, there were no duplicate entries for this database, with each line of code having a different date/time stamp for access. This data was retained in the dataset.

**Table 2.** Summary of data collection, preparation and analysis methods.

| Study Goal | Quantifying patron access of subject guides and quantifying patron access of electronic resources via subject guides and alternative information resource discovery tools within the library information ecosystem. | |
|---|---|---|
| **Gaps in literature** | • Subject guide access statistics have not been contextualised in relation to enrolment numbers.<br>• Subject discipline has not been investigated as a potential factor in differing access statistics for subject guides within the same institution. | • Subject guides usage has not been considered in relation to the usage of other resource discovery tools offered by academic libraries.<br>• Disciplinary differences in the use of resource discovery tools, including subject guides, offered by academic libraries has not yet been investigated. |
| **Research Question** | **RQ1. How many page views of subject guides can be attributed to patron use and do page view figures differ across disciplines?**<br>Sub-questions:<br>A. What proportion of subject guide page views can reasonably be attributed to patrons?<br>B. What are the page view statistics for each subject guide relative to enrolments in that subject? | **RQ2. Which resource discovery tools are used most to access electronic resources and does tool access differ across disciplines?**<br>Sub-questions:<br>A. What proportion of access to electronic resources originates from each of the following resource discovery tools: subject guides; Summon; Google Scholar; database index<br>B. Are there disciplinary differences in the proportion of access originating from the following resource discovery tools: subject guides; Summon; Google Scholar; database index |
| **Data set & source** | • record of all unique page views for all relevant subject guide pages for 4 March – 7 April 2019<br>• data from Google Analytics | • record of all hits on electronic resources provided by UC Library for 4 March – 7 April 2019<br>• data from EZproxy server |
| **Data collection** | *Prior to collection*<br>• Exclude UC Library staff IP address ranges and international access<br>*Post collection*<br>• Extract data set detailing unique page views per page from Google Analytics. Data set will include a line of data for every single subject guide page detailing total and unique page views.<br>• Request data from University of Canterbury regarding enrolment numbers per subject. | Data downloaded from the EZproxy server and saved in a plain text file. Each line of data records which user access what file and at what time.<br>e.g. [Redacted IP Address] – [Redacted Username] [19/Jul/2018:02:22:00 +1200] "GET http://ezproxy.canterbury.ac.nz:80/login?url=https://ieeexplore.ieee.org/document/962130 HTTP/1.1" 302 0<br>http://canterbury.summon.serialssolutions.com/search?q=Novel%20uses%20of%20Pinch%20Gloves |

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|---|---|---|
| **Data preparation** | 1. Sort into 64 groups, one for each subject guide listed on the UC homepage, as indicated by the title of the page. Remove data for all other guides (e.g. course; topic).<br>2. Sort 64 guides into disciplinary groups<br>3. Sort enrolment numbers per course as provided by UC into enrolment numbers per discipline. | 1. Use python to<br>  • Format and refine plain text file to required fields of information.<br>  • Exclude lines of code with staff access IP addresses.<br>  • Exclude all data with HTTP Status Codes outside of 200-399 in the Status Request field.<br>  • Exclude all lines of code with identical base URLs in the Complete Request and Prior URL fields (i.e. intra-database usage)<br>  • Exclude all lines of code with Complete Request URLs with extraneous file formats (e.g. .jpegs, .css etc)<br>  • Remove lines of code with a Complete Request URL for the UC Exam Papers Archive.<br>2. Refine dataset to include only lines of codes with hits to the 12 sample databases.<br>3. Remove lines of code that indicate inter-database resource discovery<br>4. Remove lines of code with a 300 HTTP status code and subject guide, Google Scholar or database index Prior URL field.<br>5. Manually review lines of code with a 300 HTTP status code and Summon Prior URL field to delete duplicate lines. |
| **Data analysis** | Sub-question A<br>Calculate:<br>  • total page views of all subject guides.<br>  • total page views for each subject guide as proportion of total usage.<br>Sub-question B<br>  • Calculate total page views for each disciplinary group of subject guides compared to proportion of students enrolled in that discipline.<br>1. Identify most and least accessed guides relative to student numbers for the related discipline. | Sub-question A<br>Calculate the proportion of access to sample electronic resources that originates from each resource discovery tool.<br>Sub-question B<br>Calculate access to each individual database that originates from each resource discovery tool as proportion of all usage for each sample database. |
| **Results** | Sub-question A<br>Quantify UC Library patron access to subject guides.<br>Sub-question B<br>Identify whether there are disciplinary differences in total student page views of subject guides. | Sub-question A<br>Quantify usage of the different resource discovery tools.<br>Sub-question B<br>Quantify disciplinary usage of different resource discovery tools. |

Data analysis

There are two stages of data analysis in this study:

*2. Analysis of LibGuides usage*

To answer the research sub-question: How many page views of subject guides can be attributed to UC Library patron use and do page view figures differ across disciplinary subjects?, the following statistics are calculated:

- total page views of each disciplinary group of subject guides
- page views for each disciplinary group of subject guides as a proportion of total page views
- page views for each disciplinary group of subject guides relative to student numbers for the related discipline

It is hypothesised there will be significant differences in the page view figures for particular subject guides, with a handful of highly used guides and most guides having low usage. If this is the case, then this suggests disciplinary differences in information seeking behaviour may be a factor in subject guide usage. If a number of guides have high usage, this suggests library patrons find subject guides to be relevant resource discovery tools; if usage is generally very low, this suggests library patrons may be using alternative resource discovery tools.

*3. Analysis of access data for UC Library electronic resources*

To answer the research sub-question: Which resource discovery tools are used most by library patrons to access electronic resources and does access method differ across disciplines?, the following statistics are calculated using the sample dataset:

- the proportion of access to all electronic resources that originates from each resource discovery tool
- the proportion of access to each individual database that originates from each resource discovery tool.
- a chi-squared test of independence to investigate the strength of the relationship between subject guide and resource discovery tool usage.

It is hypothesised that for databases associated with low-use subject guides, the most common referrer will be Summon or Google Scholar. Conversely, for databases associated with high-use subject guides, it is hypothesised the most common referrer will be subject guides or the database index. If this is the case, then this indicates there may be disciplinary differences in how students access resources. If this is not the case, then this means factors other than academic discipline influence how students access resources.

Ethical considerations

The inclusion of usernames and IP addresses in the data collected from the EZproxy server raises the issue of ensuring that library patrons' right to privacy is maintained, as this data could be used to identify both patron identity and associated resource access. The following steps were taken to protect the privacy of library patrons:

- Original EZproxy server data was stored on a secure user drive on the UC Library IT network.
- Once EZproxy server data had been refined to the fields and lines of code required as specified in the methodology, IP addresses and usernames were deleted from the file.

This study received ethics approval from the School of Information Management Human Ethics Committee of Victoria University of Wellington (Approval # 27251). The University of Canterbury Human Ethics Committee has a copy of this approval on file.

## Results

**Subject Guide Access**

Analysing the Google Analytics access statistics for subject guides revealed that 68.2% (24,680 of 36,166) of unique page views were likely from UC library patrons, as detailed in Table 3.

**Table 3.** Views of subject guides by audience. Approximately 31.7% (11,486 of 30,888) of total usage did not originate from UC Library patrons.

|  | **Total Views (#)** | **Percentage** |
| --- | --- | --- |
| New Zealand (excluding library staff) | 24,680 | 68.2% |
| International | 8,979 | 24.8% |
| Library staff | 2,507 | 6.9% |
| **Total** | **36,166** | **100%** |

Further analysis of the data focusses on the 24,680 views originating from within New Zealand but not from library staff. Four disciplinary groups of subject guides attracted 82% (20,279 of 24,680) of all page views. Most disciplinary groups of guides had considerably lower usage, as detailed in Table 4.

**Table 4**. Total unique page views for each disciplinary group of subject guides. Most guides had low usage, while Law & Legal Studies and Engineering had the highest use.

| Total Unique Views (per discipline) | ANZ Discipline |
| --- | --- |
| <100 | Environmental Sciences; Agricultural and Veterinary Sciences; Technology; Pacific People Studies; Information and Computing Sciences; Mathematical Sciences |
| 100-200 | Māori Studies; Philosophy and Religious Studies, Chemical Sciences, Studies in Creative Arts and Writing |
| 203 | Biological Sciences |
| 258 | Earth Sciences |
| 283 | Psychology and Cognitive Sciences |
| 421 | History & Archaeology |
| 585 | Economics |
| 765 | Medical and Health Sciences |
| 907 | Language, Communication and Culture |
| 1938 | Education |
| 2041 | Studies in Human Society |
| 6830 | Engineering |
| 9470 | Law & Legal Studies |

Visualising these page view totals as a proportion of all subject guide views, as depicted in Figure 1, reveals Law & Legal Studies and Engineering guides accounted for 66% (16,300 views) of all subject guide page views.
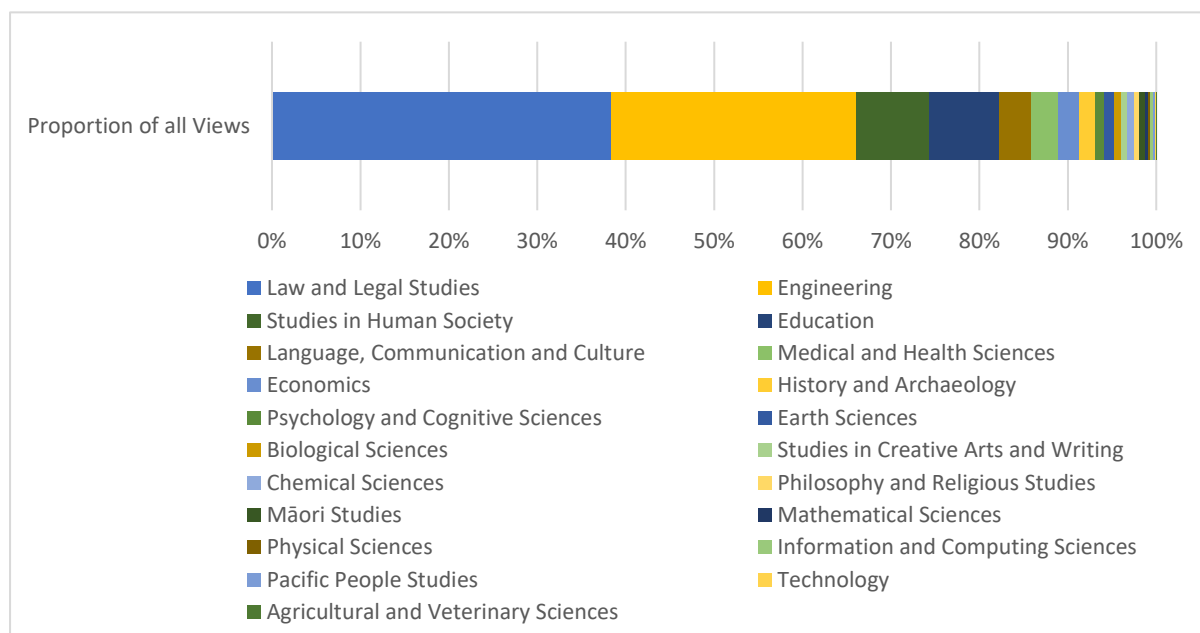


**Figure 1.** Unique page views for each disciplinary group of subject guides as a proportion of total page views. Subject guides for Law and Legal Studies attracted the greatest share (38%; 9,470 view) of all subject guide page views.

Looking at page views for each disciplinary group of subject guides relative to disciplinary enrolment share, as depicted in Figure 2, reveals that Law & Legal Studies and Engineering subject guides accounted for a disproportionately high share of unique page views.
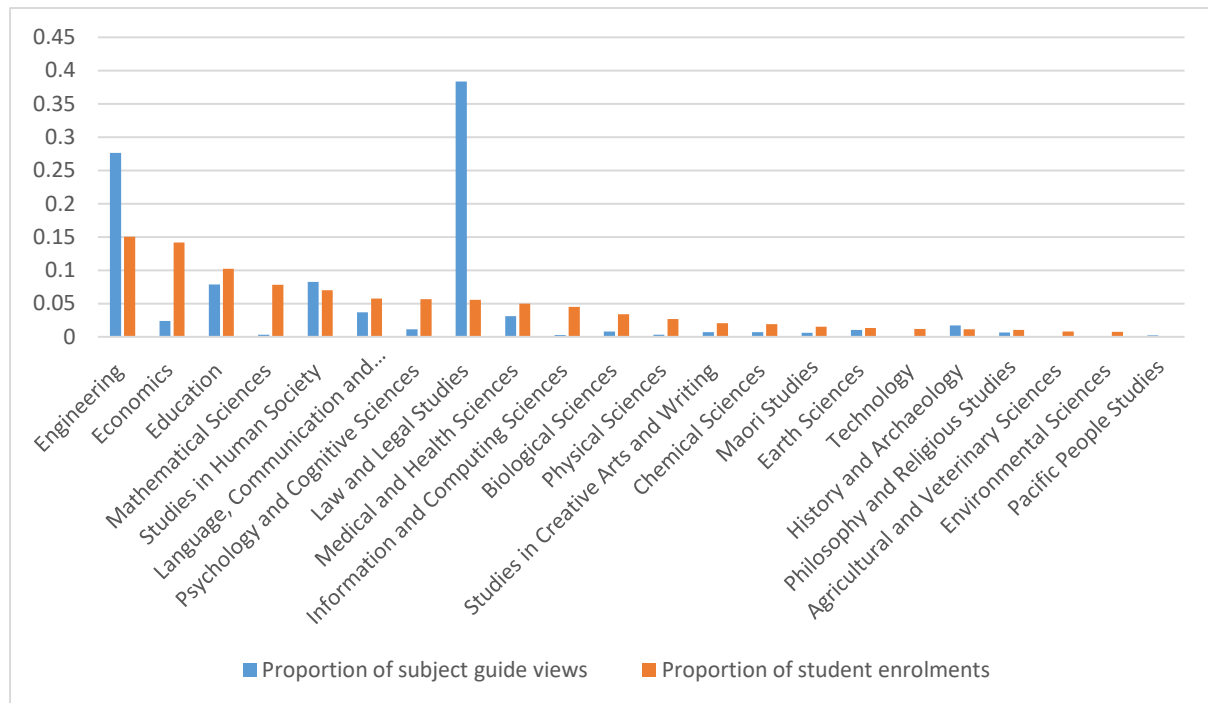


**Figure 2.** Proportion of disciplinary subject guide page views compared to proportion of disciplinary enrolments. This figure provides a more nuanced view than raw page view data, revealing that some guides with low raw data (such as Studies in Human Society and History & Archaeology) are achieving a disproportionately high share of total unique page views.

However, closer analysis of the data revealed the presence of course-specific pages in some guides. Previous studies have found that course guides attract higher views than disciplinary guides (Bowen, 2012; Chiware, 2014; Yeo, 2011). The inclusion of data for course-specific pages distorted this investigation of student use of disciplinary subject guides so the data was recalculated to exclude unique views for eight course-specific pages (see Appendix C). Figure 3 shows that removing course-specific pages revealed that the engineering subject guides actually attracted a disproportionately low share of subject guide views. In fact, with the exception of Law & Legal Studies, Studies in Human Society, History & Archaeology, Pacific People Studies, and Education, all other (17 of 22) disciplinary groups of guides had disproportionately low subject guide usage.
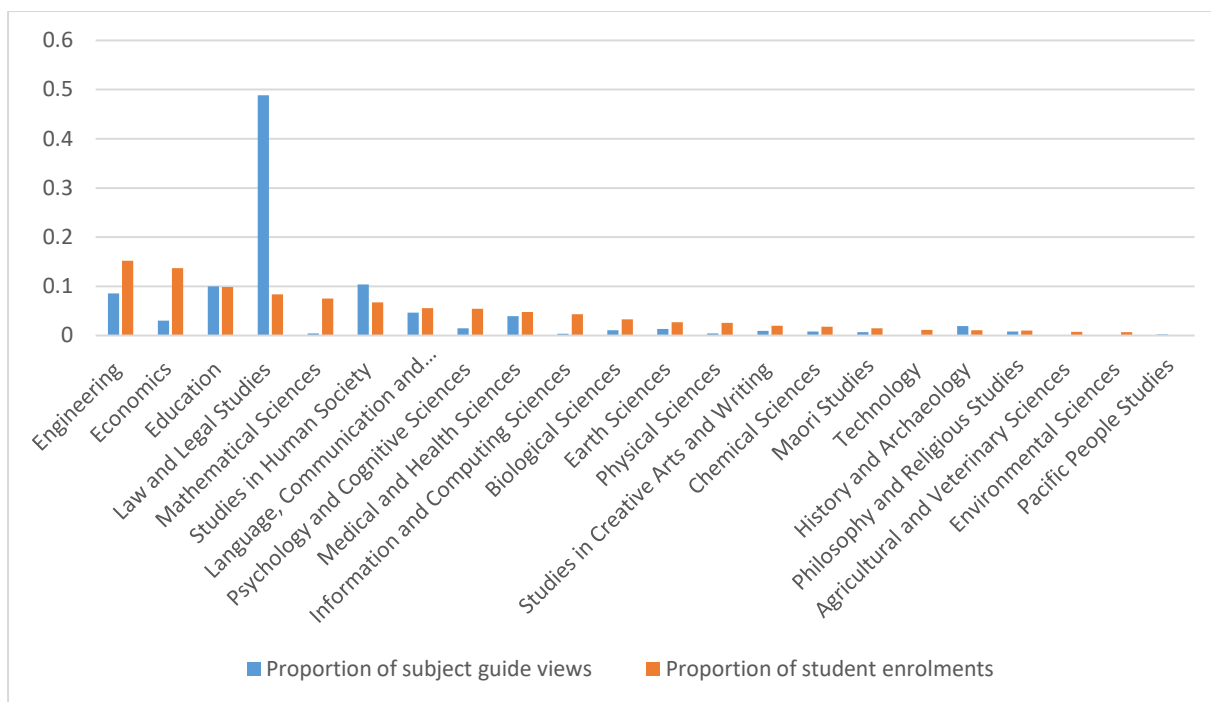
**Figure 3.** Proportion of disciplinary subject guide page views compared to proportion of disciplinary student enrolments excluding course pages. This analysis revealed that Engineering had a disproportionately low share of subject guide page views.

Visualising the difference between each discipline's share of total subject guide views and share of total enrolments, as in Figure 4, makes it easier to identify guides with disproportionately high and disproportionately low use.
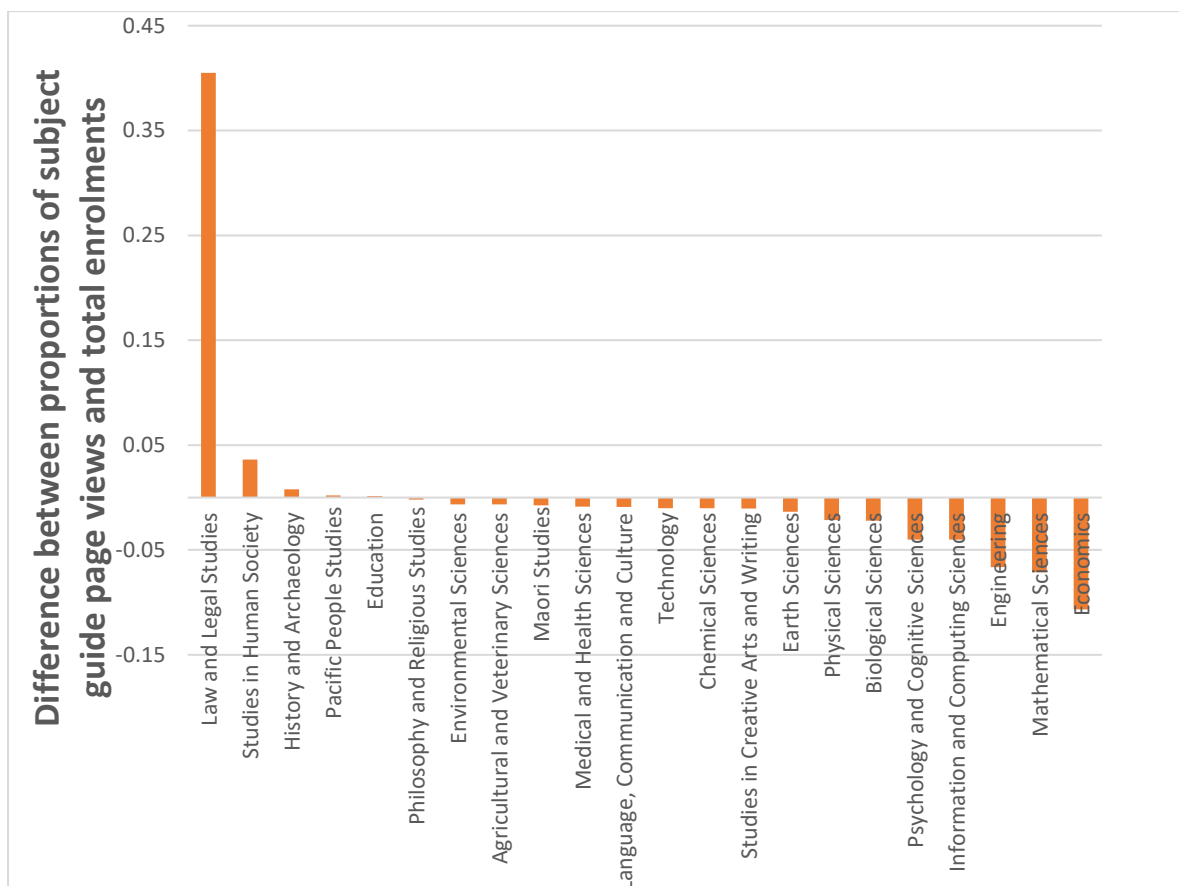
**Figure 4.** A clustered bar chart depicting the difference between disciplinary share of total subject guide page views and share of total enrolments. Disciplinary groups with a disproportionately high use have a positive score on the Y-axis while those with disproportionately low use have a negative score on the X-axis.

In addition to Law & Legal Studies, History & Archaeology and Studies in Human Society also had disproportionately high use.[7] In contrast, Economics, Mathematical Sciences, and Engineering had disproportionately low use. These six disciplines were selected as the sample disciplines to investigate resource discovery tool access.

**Resource Discovery Tool Access**

Disciplinary databases were selected based on the core databases listedon the sample subject guides and are detailed in Table 5.

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[7] While Pacific People Studies and Education also attracted a slightly higher share of total subject guide views than total enrolments, the difference was small.

**Table 5.** Selected sample databases and associated discipline. Multidisciplinary databases such as Scopus or JSTOR were excluded from selection.

| | Discipline | Databases |
|---|---|---|
| **High Access Subject Guides** | Law & Legal Studies | Westlaw NZ |
| | | Hein Online |
| | History & Archaeology | Historical Abstracts |
| | | Cambridge Histories |
| | Studies in Human Society | Sociological Abstracts |
| | | Political Science Complete |
| **Low Access Subject Guides** | Economics | Business Source Complete |
| | | OECD iLibrary |
| | Engineering | IEEE |
| | | Compendex |
| | Mathematical Sciences | MathScinet |
| | | ACM Digital Library |

Data for the 12 sample databases was analysed to identify the proportion of access to electronic resources that originated from each of the four following resource discovery tools: subject guides; Summon; Google Scholar; and the database index.[8] Figure 5 shows that Summon was used for roughly half of the access to electronic resources, with subject guides used almost one-quarter of the time. The database index and Google Scholar were the least used resource discovery tools.

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[8] These four discovery tools constitute the overwhelming majority of tools used to access electronic resources. However, there was some data for other tools including the UC learning management system, a journal search function embedded on the library website, the library catalogue, the Massey University learning management system (UC and Massey offer some several conjoint courses), Google and Yandex (a Russian search engine). The number of referrals for these were so low that they have not been considered in this analysis. Other minimal (as in a single digit) referrals came from AskLive (UC Library's instant message service), Bit.ly links, Facebook, Gmail, Google, Messenger, and QQ.com (a Chinese message service). The latter represent access via links, rather than independent searches for information and have thus been removed from the sample.
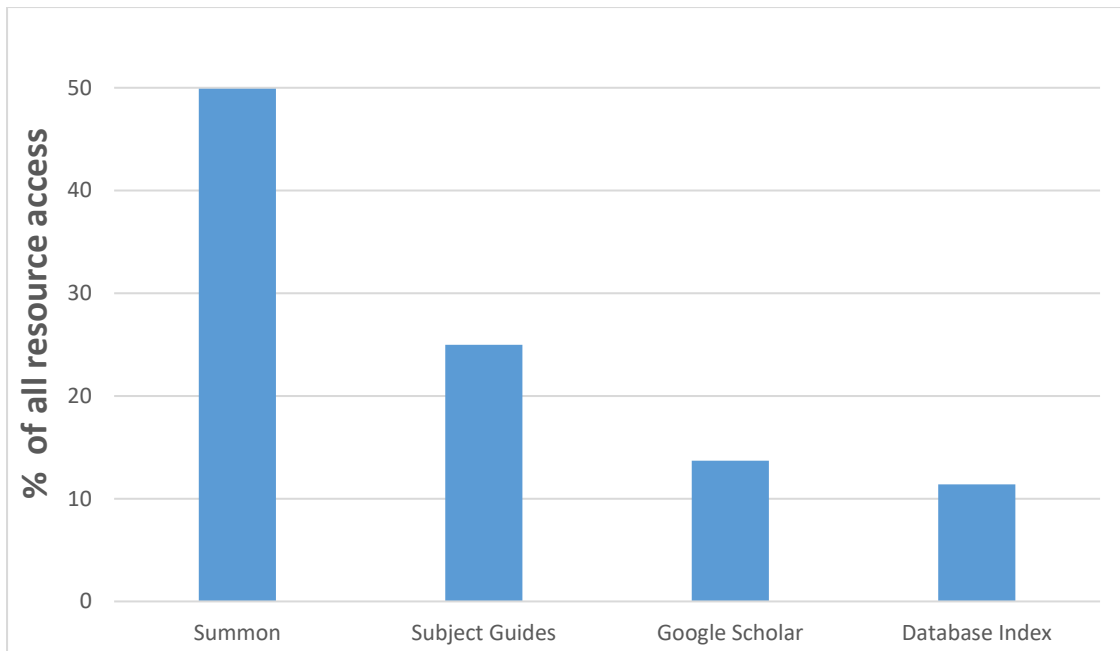
**Figure 5.** Proportion of library patron access to electronic resources via the four main resource discovery tools. Summon was the referrer for almost 50% of all resource access.

However, as shown in Figure 6, the use of these discovery tools varies between high and low subject guide access disciplines.
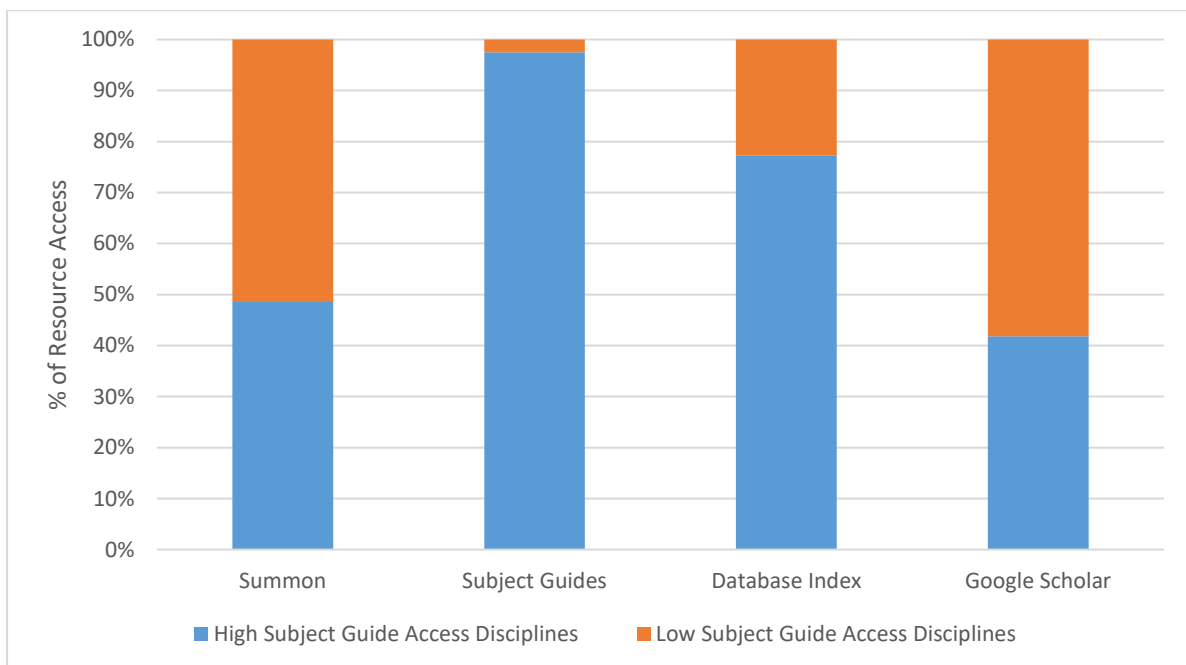


**Figure 6.** Comparison of resource discovery tool usage between high and low subject guide access disciplines. High subject guide use disciplines account for the majority of access via subject guides and the database index, while the use of Summon and Google Scholar is more evenly spread, regardless of discipline.

For databases associated with low-use subject guides (Economics, Engineering and Mathematical Sciences), the most common referrer is Summon.  Conversely, for databases associated with high-use subjects (Law & Legal Studies, Studies in Human Society, and History & Archaeology), subject guides and Summon are the most common referrers. The Law & Legal Studies data is distinct from the other high subject guide use disciplines, with Summon the most common referrer to the sample Law databases. When Law & Legal Studies is excluded from high subject guide access disciplines data, subject guides and database index are the most frequently used resource discovery tool as can be seen in Figure 7.
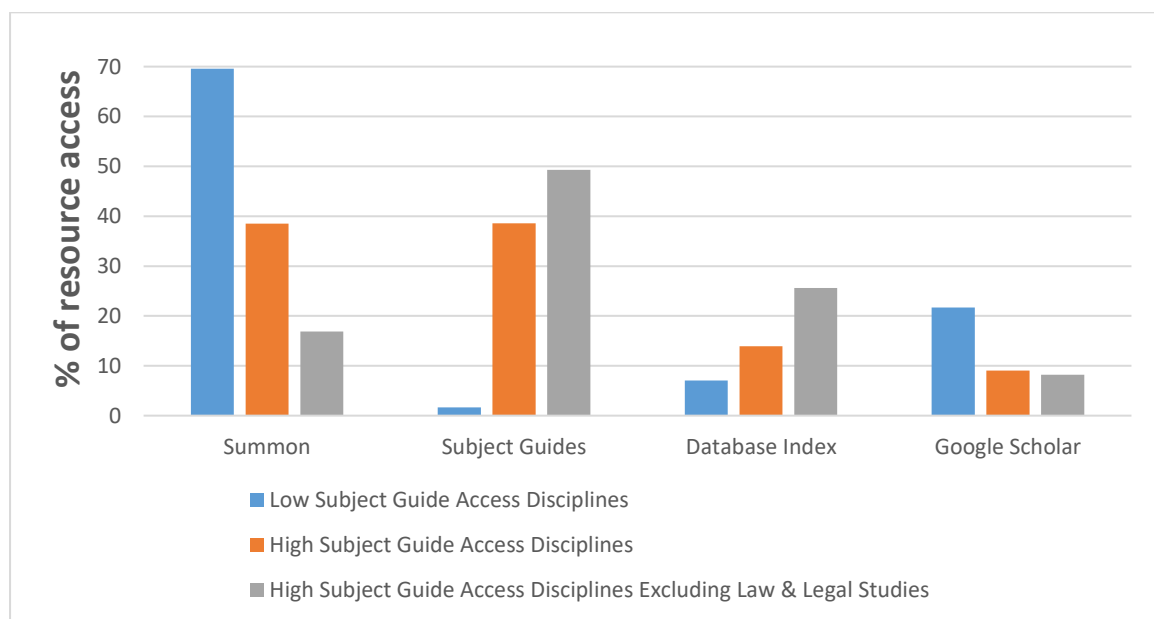


**Figure 7.** Discovery tool usage in relation to subject guide usage. High subject guides use disciplines used subject guide and the database index more frequently, while low subject guide access disciplines used Summon and Google Scholar more frequently.

To identify whether, as hypothesised, the most common referrer for databases associated with low-use subject guides was Summon or Google Scholar, while the most common referrer for databases associated with high-use subject guides was subject guides or the database index, the results were organized into a 2 x 2 contingency table (see Table 6) to represent these four categories.

**Table 6.** 2 x 2 contingency table displaying the frequency distribution of referrers for databases associated with high and low subject guide access disciplines

| | Discipline-specific discovery tools (i.e. subject guides/database index) | Multidisciplinary discovery tools (i.e. Summon/Google Scholar) | Totals |
|---|---|---|---|
| **High Subject Guide Access Disciplines** | 856 | 776 | **1632** |
| **Low Subject Guide Access Disciplines** | 83 | 867 | **950** |
| **Totals** | **939** | **1643** | **2582** |

The discrepancy between high and low subject guide access disciplines' use of discipline-specific discovery tools indicates a contingency between disciplinary subject guide access and discipline-specific discovery tools. However, there is not the same discrepancy in the use of multidisciplinary discovery tools, indicating that disciplinary subject guide usage is independent of multidisciplinary tool access.

A chi-squared test of independence is designed to examine relationships between nominal variables (Vaughan, 2003), so was used to examine the relationship between discovery tool and subject guide access, finding $X^2(1, N = 2852) = 7.64, p < .01$. This result indicates a strong relationship between discovery tool and subject guide access, and that this study's findings are unlikely to be due to chance. It is therefore inferred that the choice of resource discovery tool to access a disciplinary database is not independent from subject guide access for that discipline. Calculating odds ratios for these relationships further explicates the association between the variables, as shown in Table 7.

**Table 7.** Odds ratios demonstrating the association between low and high subject guide access disciplines and referrers for database. There is a strong association between low subject guide access and the access of multidisciplinary discovery tools.

| | Discipline-specific discovery tools (i.e. subject guides/database index) | Multidisciplinary discovery tools (i.e. Summon/Google Scholar) |
|---|---|---|
| **High Subject Guide Access Disciplines** | 1.103092784 | 0.906542056 |
| **Low Subject Guide Access Disciplines** | 0.095732411 | 10.44578313 |

While high subject guide usage is positively associated with accessing resources via subject guide or the database index (1.10), this association is not strong nor is the negative association with the use

of Summon or Google Scholar particularly strong. Yet, low subject guide usage is very positively associated with accessing resources via Summon or Google Scholar (10.4), and very negatively associated with the use of subject guides and the database index (0.09).

Given the high use of subject guides as a discovery tool by high subject guide access disciplines in the descriptive analysis, the low odds ratio for this association was surprising. Assuming that the high use of Summon as a discovery tool for accessing Law & Legal Studies databases was responsible for the low odds ratio, the odds ratios were recalculated excluding Law & Legal Studies data to investigate whether there was a stronger association for the other two high subject guide access disciplines (see Table 8).

**Table 8.** Odds ratios demonstrating the association between low and high subject guide access disciplines and referrers for database, excluding data from Law & Legal Studies.

| | Discipline specific discovery tools (i.e. subject guides/database index) | Multidisciplinary discovery tools (i.e. Summon/Google Scholar) |
|---|---|---|
| **High Subject Guide Access Disciplines** | 2.981818182 | 0.335365854 |
| **Low Subject Guide Access Disciplines** | 0.095732411 | 10.44578313 |

The odds ratio of 2.98 demonstrates a much stronger association between high disciplinary subject guide usage and usage of discipline-specific discovery tools to access resources for Studies in Human Society and History & Archaeology.

## Discussion

### Subject Guide Access

Answering Research Question 1(a), *What proportion of UC subject guide page views can reasonably be attributed to patrons?,* this study found that 68.2% of subject guide access originates from within New Zealand, suggesting that the majority of page views of subject guides can be attributed to UC Library patron use. While one study at Cornell University found up to 70% of access was from users unaffiliated with the library (Castro-Gessner, Wilcox, & Chandler, 2013), this finding is mirrors that found in a more recent study at the University of South Florida (Griffin & Taylor, 2018). Nonetheless, almost a third of all subject guide page views are not from UC Library patrons. This figure, in and of itself, is not necessarily alarming if subject guides are generally well-used by library patrons, since such access could be considered good marketing for the institution as well as an example of

information as a public good. However, while the guide for Law & Legal Studies had notably high access, all other disciplinary guides had much lower total access counts with only three other guides exceeding 1000 hits. Raw counts are difficult to evaluate, as there is no standard by which to judge subject guide usage. While some studies have detailed usage statistics in raw numbers (Castro-Gessner et al., 2013; Griffin & Taylor, 2018; Yeo, 2011) most do not, making it difficult to identify any average usage levels. In any case, the different number of guides, number of students, and periods of data collection in each study complicates drawing meaningful comparisons. Given the depth of literature on subject guides, such a meta-analysis would be a valuable future research project to enable libraries to evaluate the performance of their subject guides.

The data gathered to answer Research Question 1(b), *What are the page view statistics for each subject guide relative to enrolments in that subject?,* revealed disciplinary guides for Law & Legal Studies, Studies in Human Society, History & Archaeology, Pacific People Studies and Education disciplines all achieved a disproportionately high share of unique page views. Most guides had low usage, and the unique page views for the Law & Legal Studies subject guide far exceeded other guides, with Studies in Human Society and History & Archaeology guide lagging far behind as the second and third most viewed guides. This distribution of use is not dissimilar to that found at Cornell University by Castro-Gessner et al. (2013), where seven percent of guides attracted the bulk of subject guide traffic, raising the question of why there is such disparity in use.

A range of factors that influence subject guide usage, including the role of library instruction and location of guides on the Website. The Law subject guide is heavily promoted in compulsory library workshops that are embedded within the Law programme. Other disciplines at UC are not yet embedded within programme curricula, with the result that the subject guides are not as systematically positioned as a necessary tool for information discovery. But there is conflicting evidence as to the importance of instruction in influencing student selection of discovery tools, with Kim (2011) finding it was an important factor, while Joo and Choi (2015) found it was not. Such inconsistency is evident in this study, with subject guides for the Studies in Human Society, History & Archaeology, Pacific People Studies and Education disciplines attracting a great share of page views than expected from enrolments, despite not being promoted via embedded curriculum content. It seems likely that some specificity about information discovery for these disciplines makes subject guides important resource discovery tools.

It is established that course-specific content, such as course guides, attract greater usage than subject guides (Adebonojo, 2010; Yeo, 2011), and this was reflected in the high access counts for one page of an Engineering subject guide that focussed on resources for a very large first-year course assignment. Yet, even though this subject guide was embedded within the course (students

were referred to the guide in the Assignment instructions and a link was embedded in the course page on the Learning Management System), the usage of the course-specific page did not translate to an increase in page views of other pages within the Engineering subject guides. That is to say, the annual development of a course-specific page for Engineering students in the largest 100-level course (which is offered annually to each first year cohort) does not lead to a proportionate increase in usage of the Engineering discipline subject guides in general. This suggests that the students did not recognise the guides as relevant to their continuing study and highlights that embedding subject guides within the curriculum will not necessarily lead to high use.

Another important factor to consider in the usage of subject guides is their location on the library website. Accessing a specific subject guide via the UC Library website requires a minimum of four clicks once on the Website's homepage, as they are located in a drop down menu on the homepage. In comparison, the Summon search box is located on the homepage. Unless patrons have bookmarked the guide or clicked on a direct link, accessing a subject guide requires prior knowledge of the guide and its location – and greater effort than accessing the Summon search box on the homepage. The impact of the number of clicks on information resource access has been documented (Vecchione et al., 2016), and the finding that fewer links leads to greater usage corresponds with the Principle of Least Effort (Case, Given, & Mai, 2016). This principle that people will inherently expend the least effort possible to complete a task is a likely factor in understanding subject guide usage, especially given findings that convenience and/or ease-of-use are the primary factors informing students' selection of information resources (Connaway, Dickey, & Radford, 2011; Joo & Choi, 2015; Thomsett-Scott & Reese, 2012). The fact that some subject guides in this study attracted high use in spite of the effort required to access them strengthens the suggestion that these guides were considered relevant resource discovery tools.

In summary, to answer Research Question 1, *How many page views of subject guides can be attributed to patron use and do page view figures differ across disciplines?,* this study has found that almost two-thirds of page views can be attributed to patron use and that a handful of disciplinary guides attracts the bulk of page views. The low usage for most subject guides suggests library patrons in these disciplines may be using alternative resource discovery tools.

**Resource Discovery Tool Access**

Answering Research Question 2(a), *What proportion of access to electronic resources originates from each of the following resource discovery tools: subject guides; Summon; Google Scholar; database index*, this study found that Summon was the most commonly used resource discovery tool, accounting for just short of 50% of all searches. This matches earlier findings regarding the

popularity of Web-scale discovery tools (Mussell & Croft, 2013; Way, 2010). Perhaps unexpectedly given the data for subject guide usage, just under 25% of searches started with subject guides, with the remaining access originating from the database index and Google Scholar.

The data analysed to answer Research Question 2(b), *Are there disciplinary differences in the proportion of access originating from the following resource discovery tools: subject guides; Summon; Google Scholar; database index,* revealed distinct disciplinary differences in use of the four resource discovery tools. Disciplinary differences in library usage has been found in previous studies (Beasley, 2016; Jara et al., 2017; Kim, 2011), but this study is the first to compare use of discovery tools by discipline. The disciplinary differences in the usage of tools is most starkly illustrated by the data for multidisciplinary resource discovery tools. For disciplines with high subject guide usage, 15-50% of all searches started in Summon or Google Scholar. In comparison, for disciplines with low subject guide usage, 85-95% of all searches started in Summon or Google Scholar.

Given studies demonstrating patron preference for the Google Scholar interface (Greenberg & Bar-Ilan, 2017; Wells, 2016; Wilkes & Gurney, 2009), it was expected that Google Scholar would be used for resource discovery more frequently than demonstrated in this study. Even in disciplines heavily reliant on Summon, such as Engineering and Mathematical Sciences, which would plausibly lead to the use of another one-search box tools such as Google Scholar, usage was comparatively low. The only exception was Economics, where Google Scholar accounted for over one third of all searches. The inclusion of Marketing in the Economics discipline and the particular information needs of this subject (such as consumer and corporation information) may account for the higher use of Google Scholar, a conclusion supported by previous research that found business students were more likely to use commercial websites than library resource discovery tools (Kim, 2011).

As expected from the subject guide access figures for Law & Legal Studies, subject guides were heavily used to access the Law databases. However, given the subject guide is positioned as the starting point for research in embedded tutorials, it is notable that Summon was used slightly more. Students in Law are often enrolled in other disciplinary courses, raising the possibility that the dominance of Summon as a resource discovery tool in other disciplines leads to its usage in spite of instruction. This further strengthens the suggestion that the Principle of Least Effort informs resources discovery tool selection, with a focus on convenience and ease of use (Joo & Choi, 2015; Thomsett-Scott & Reese, 2012). It is possible that students try Summon, before returning to the subject guide to find resources, but the inclusion of only 2-300 HTTP status codes in this study suggests that Summon is providing access to resources. This raises the possibility that Summon will gain further dominance in this discipline as a resource discovery method, especially as Web-scale functionality continues to evolve.

Studies in Human Society also had particularly high resource discovery referrals from subject guides, with over half of searches starting in the subject guides. Criminal Justice is included in this discipline, and is a subject closely allied with Law at UC, raising the possibility that curriculum-embedded promotion by the same subject librarian, akin to that for Law, has led to the dominance of the subject guide as a research starting point. However, the databases Political Science Complete (mainly used in Political Science, the guide for which attracted subject guide access comparative with that for Criminal Justice) and Sociological Abstracts (used for almost all of the subjects in this discipline) were the two sample databases. Interestingly, History & Archaeology was the one discipline for which the database index was the most accessed resource discovery tool. Qualitative research is required to unpack the reason for these disciplinary differences in resource discovery tool selection, but given what is known more broadly about information behaviour it seems likely that these discipline-specific tools are perceived as better for discovering appropriate resources than multidisciplinary resource discovery tools (Kim, 2011).

In summary, to answer Research Question 2, *Which resource discovery tools, including subject guides, are used most to access electronic resources and does access method differ across disciplines?*, Summon and subject guides were the resource discovery tools used most to access electronic resources but there were substantial differences between disciplines.

**The role of subject guides in resource discovery**

Looking at the data in term of disciplines with high subject guide access and disciplines with low subject guide access has revealed a strong association between disciplinary subject guide and discovery tool access. As hypothesised, high disciplinary subject guide usage is positively associated with the use of discipline-specific discovery tools (subject guides and database indexes) to access resources. Conversely, low disciplinary subject guide usage is positively associated with the use of multidisciplinary discovery tools to access resources. This suggests that subject guides need to be evaluated in relation to disciplinary needs and the range of resource discovery tools offered by a library. Much has been written about how to better design, locate and market subject guides. This study highlights the need for a more holistic view of subject guides that takes into account discipline and the information discovery context. Given the low usage found for most subject guides and the dominance of Summon, in particular, as a resource discovery tool amongst disciplines with low subject guide use, the creation of subject guides for some disciplines may not be an effective method for supporting patrons in resource discovery regardless of design, location or marketing.

## Assumptions and limitations

This analysis of subject guide and resource discovery access rests on a number of assumptions. The first is that although this study excludes library staff and international access to subject guides, the remaining access could be by any individual within New Zealand and therefore include some access by users unaffiliated with UC. However, the sizable distance student cohort at UC precluded refining the geographical location of users any further. However, there is no reason to think that non-UC users would access any particular subject guide more than they would access any other. Given this, along with the fact that usage is analysed in terms of proportions rather than absolute figures, it is assumed any non-UC usage does not significantly influence the results.

The Term 1 timeframe for data collection provides a snapshot of resource discovery that may not accurately reflect patron behaviour. While the two first two weeks of terms were excluded from data collection because of the high likelihood that instruction and promotion would inflate access statistics, it is still possible that these activities have had a short-term influence on resource access behaviour that may not be sustained throughout the academic year. In addition, the resource discovery behaviour of research students and academic staff may vary across the year depending on teaching load. Collecting data over a full academic year, or more, would gain a more reliable picture of resource access.

Another potential limitation is the assumption that resource discovery statistics for the six sample disciplines are representative of that discipline's resource discovery behaviour. The two databases chosen for each sample discipline were chosen because they were discoverable by each of the four tools being studied and because they were distinctly disciplinary. A large number of disciplines also rely on multidisciplinary databases but due to the complexity of distinguishing the discipline for any individual search, these were not considered for the sample. A future study that links a user's identity to a particular discipline would allow a more comprehensive sample of databases, although this may be difficult for users in multidisciplinary fields or enrolled in multiple disciplines.

## Future research

Understanding how users are discovering information without understanding why they chose a particular method tells only half the story. For example, access counts only tell us patrons used a resource discovery tool, not whether they found what they needed. This study reveals disciplinary differences in resource discovery and makes some speculations regarding what underpins these differences based on the Principle of Least Effort. Future studies that conduct similar analyses are necessary to confirm disciplinary differences, as are studies that unpack the reasons for disciplinary differences.

EZproxy server logs offer libraries rich insight into patrons' information discovery behaviour. While this study has focussed on how patrons start their search for information on the website, further research might take a broader view and look at inter-database and intra-databased resource discovery.

## Conclusion

Understanding which resource discovery tools and services patrons are using is essential for meeting patrons' information needs and the wise management of library resources. Subject guides are an established tool offered by academic libraries to help patrons find resources but there is little data confirming that patrons find them useful tools. This study found low usage of subject guides, with the exception of a handful of disciplines. It is possible that patrons in some disciplines do not find subject guides useful resources, an idea lent some support by the disciplinary differences found in information resource discovery. Disciplines that had high access rates for subject guides were more likely to commence information resource searches in subject guides or a specific database, while disciplines with low access rates for subject guides were more likely to commence information resource searches in Summon or Google Scholar

Much has been written about subject guides and how to boost their usage. The findings of this study suggest that subject guide usage cannot be meaningfully evaluated in isolation from the broader information discovery context. That is, academic discipline and the other resource discovery tools offered by the library have a bearing on the usage of subject guides. Given the low usage found for most subject guides and the dominance of Summon, in particular, as a resource discovery tool, the creation of subject guides for some disciplines may not be a useful method for supporting patrons in resource discovery. Further research into disciplinary differences in resource discovery is required but offers a rich opportunity to develop and promote resource discovery tools according to patron need.

## Appendix A: Academic Disciplines as defined in Australian and New Zealand Standard Research Classification (ANZSRC)

| | |
|---|---|
| 01 | Mathematical Sciences |
| 02 | Physical Sciences |
| 03 | Chemical Sciences |
| 04 | Earth Sciences |
| 05 | Environmental Sciences |
| 06 | Biological Sciences |
| 07 | Agricultural & Veterinary Sciences |
| 08 | Information & Computing Sciences |
| 09 | Engineering |
| 10 | Technology |
| 11 | Medical &Health Sciences |
| 12 | Built Environment & Design |
| 13 | Education |
| 14 | Economics |
| 15 | Commerce, Management, Tourism & Services |
| 16 | Studies in Human Society |
| 17 | Psychology & Cognitive Sciences |
| 18 | Law & Legal Studies |
| 19 | Studies in Creative Arts & Writing |
| 20 | Language, Communication & Culture |
| 21 | History & Archaeology |
| 22 | Philosophy & Religious Studies |

Aboriginal & Torres Strait Islander Studies

Māori Studies

Pacific People Studies

Classification reproduced from Australian and New Zealand Standard Research Classification (Pink & Bascand, 2008, pp. 12-13)

## Appendix B: Academic disciplines at UC assigned to ANZSRC Classification

| ANZ Disciplines | UC Subjects | Subject Guides |
|---|---|---|
| **Mathematical Sciences** | Mathematics | http://canterbury.libguides.com/math |
| | Statistics | http://canterbury.libguides.com/stat |
| **Physical Sciences** | Astronomy | http://canterbury.libguides.com/astr |
| | Physics | http://canterbury.libguides.com/phys |
| | Medical physics | http://canterbury.libguides.com/mdph |
| **Chemical Sciences** | Chemistry | http://canterbury.libguides.com/chem |
| **Earth Sciences** | Geology | http://canterbury.libguides.com/geol |
| | Antarctic studies | http://canterbury.libguides.com/anst |
| | Geography | http://canterbury.libguides.com/geog |
| **Environmental Sciences** | Waterways | http://canterbury.libguides.com/waterways |
| | Environmental science* | |
| | Disaster risk & resilience | http://canterbury.libguides.com/drr |
| **Biological Sciences** | Biology/Ecology | http://canterbury.libguides.com/biol |
| | Biochemistry | http://canterbury.libguides.com/bchm |
| **Agricultural & Veterinary Sciences** | Forestry | http://canterbury.libguides.com/fore |
| **Information and Computing Sciences** | Computer science & software engineering | http://canterbury.libguides.com/cosc |
| **Engineering** | Chemical engineering | http://canterbury.libguides.com/ench |
| | Civil & natural resources engineering | http://canterbury.libguides.com/encn |
| | Construction engineering | http://canterbury.libguides.com/construction |
| | Earthquake engineering | http://canterbury.libguides.com/earthquakeengineering |
| | Electrical/Electronic engineering | http://canterbury.libguides.com/enel |
| | Engineering geology | http://canterbury.libguides.com/engineering_geology |
| | Intermediate engineering | http://canterbury.libguides.com/engr |
| | Engineering management | http://canterbury.libguides.com/enmg |
| | Fire engineering | http://canterbury.libguides.com/enfe |
| | Mechanical engineering | http://canterbury.libguides.com/enme |
| | Transport engineering | http://canterbury.libguides.com/entr |
| **Technology** | Product design | http://canterbury.libguides.com/Product-Design |
| | Human interface technology* | |
| **Medical & Health Sciences** | Health sciences | http://canterbury.libguides.com/hlth |
| | Communication disorders | http://canterbury.libguides.com/cmds |
| | Sports coaching | http://canterbury.libguides.com/spco |
| **Education** | Teacher Education/Educational studies & leadership | http://canterbury.libguides.com/educ |
| | | http://canterbury.libguides.com/maori_ed |

| Economics | Economics - theory & applied, Finance, Accounting, Taxation, Business, Management, Marketing | http://canterbury.libguides.com/bsec |
|---|---|---|
| **Studies in Human Society** | Criminal justice | http://canterbury.libguides.com/crju |
| | Anthropology | http://canterbury.libguides.com/anth |
| | Political science | http://canterbury.libguides.com/pols |
| | Human services/Social work | http://canterbury.libguides.com/SOWK |
| | Sociology | http://canterbury.libguides.com/soci |
| | EU studies | http://canterbury.libguides.com/euro |
| **Psychology & Cognitive Sciences** | Psychology | http://canterbury.libguides.com/psyc |
| **Law & Legal Studies** | Law | http://canterbury.libguides.com/laws |
| **Studies in Creative Arts and Writing** | Art theory | http://canterbury.libguides.com/art; |
| | Cinema studies | http://canterbury.libguides.com/cine |
| | Visual arts* | |
| | Creative writing* | |
| **Language, Communication & Culture** | Communication, journalism & media studies | http://canterbury.libguides.com/coms |
| | Cultural studies | http://canterbury.libguides.com/cult |
| | Chinese | http://canterbury.libguides.com/chin |
| | English language | http://canterbury.libguides.com/esol |
| | Japanese | http://canterbury.libguides.com/japa |
| | French | http://canterbury.libguides.com/fren |
| | Russian | http://canterbury.libguides.com/russ |
| | Te Reo | (see Māori discipline) |
| | Spanish | http://canterbury.libguides.com/span |
| | German | http://canterbury.libguides.com/grmn |
| | Linguistics | http://canterbury.libguides.com/ling |
| | English literature | http://canterbury.libguides.com/engl |
| | Digital humanities | http://canterbury.libguides.com/digi |
| | Classics | http://canterbury.libguides.com/clas |
| | Music | http://canterbury.libguides.com/musa |
| **History & Archaeology** | History | http://canterbury.libguides.com/hist |
| | | http://canterbury.libguides.com/nzhist |
| **Philosophy & Religious Studies** | Philosophy | http://canterbury.libguides.com/phil |
| **Māori Studies** | Māori | http://canterbury.libguides.com/maor |
| **Pacific People Studies** | Pacific studies | http://canterbury.libguides.com/pacs |

*Subject taught at UC but no corresponding subject guide on UC Library Website.

Appendix C: Course specific pages within subject guides

| Discipline | Subject Guide | Course Specific Page | Total Unique Page Views |
|---|---|---|---|
| Engineering | Engineering Intermediate | ENGR101 Intermediate Seafood Plastics Page | 5173 |
| Chemical Sciences | Chemistry | CHEM 281/BCHM281 | 14 |
| History & Archaeology | History | HIST136 | 48 |
| History & Archaeology | History | HIST137 | 2 |
| History & Archaeology | History | HIST294/394 | 3 |
| Māori Studies | Māori | MAOR107 | 16 |
| Studies in Human Society | Political Science & International Relations | POLS103 | 20 |
| Studies in Human Society | Political Science & International Relations | POLS104 | 9 |

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