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Article

Understanding Patterns of Library Use Among Undergraduate Students from Different Disciplines

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Abstract

Objective – To test whether routinely-generated library usage data could be linked with information about students to understand patterns of library use among students from different disciplines at the University of Huddersfield. This information is important for librarians seeking to demonstrate the value of the library, and to ensure that they are providing services which meet user needs. The study seeks to join two strands of library user research which until now have been kept rather separate – an interest in disciplinary differences in usage, and a methodology which involves large-scale routinely-generated data.

Methods – The study uses anonymized data about individual students derived from two sources: routinely-generated data on various dimensions of physical and electronic library resource usage, and information from the student registry on the course studied by each student. Courses were aggregated at a subject and then disciplinary level. Kruskal-Wallis and Mann Whitney tests were

used to identify statistically significant differences between the high-level disciplinary groups, and within each disciplinary group at the subject level.

Results – The study identifies a number of statistically significant differences on various dimensions of usage between both high-level disciplinary groupings and lower subject-level groupings. In some cases, differences are not the same as those observed in earlier studies, reflecting distinctive usage patterns and differences in the way that disciplines or subjects are defined and organised. While music students at Huddersfield are heavy library users within the arts subject-level grouping arts students use library resources less than those in social science disciplines, contradicting findings from studies at other institutions, Computing and engineering students were relatively similar, although computing students were more likely to download PDFs, and engineering students were more likely to use the physical library.

Conclusion – The technique introduced in this study represents an effective way of understanding distinctive usage patterns at an individual institution. There may be potential to aggregate findings across several institutions to help universities benchmark their own performance and usage; this would require a degree of collaboration and standardisation. This study found that students in certain disciplines at Huddersfield use the library in different ways to students in those same disciplines at other institutions. Further investigation is needed to understand exactly why these differences exist, but some hypotheses are offered.

Introduction

Libraries and librarians have often been accused of deciding on what's best for the user without consultation (Wells, 1996; Wilson, 2000; Tilley, 2013). "One of the most complex issues to deal with in acquiring knowledge about students is concerned with the assumptions library staff make about student behaviour" (Tilley, 2013, p.84).

However, in times of austerity in higher education funding, increased competition for financial resources within a University as well as increased competition between universities this approach is no longer adequate. Simply counting data, such as anonymized usage statistics, or assuming that librarians and libraries know 'best' is no longer enough. Libraries must justify both their value and impact to university senior management and to the student body who want to see their fees are invested in services that will add value to their studies. However, as Oakleaf suggests, "Librarians can develop systems that will allow data collection on individual user library behaviour"… …"Until librarians do that, they will be blocked in many of their efforts to demonstrate value" (Oakleaf, 2010, p.96).

One important aspect of this work is recognizing different patterns of usage among different groups of library patrons. We have long known that information behaviours are very different in different disciplines (Covi, 1999; Whitmire, 2002). In order to develop services which meet these different needs, and to thereby show that the library has value, librarians must first understand patterns of need and usage among different groups.

The first stage of the Library Impact Data Project (LIDP), based at the University of Huddersfield, established that a statistically significant relationship existed across a number of UK universities between library activity data and student attainment (Stone & Ramsden, 2013). The second phase of the project looked at the data in more detail to establish whether there is a relationship between subject discipline and

undergraduates' use of academic libraries. The paper will outline the methodology of the research and present findings that show that there is a statistically significant difference between various disciplines on several different dimensions of physical and electronic library usage. The paper concludes with a discussion of the findings and recommendations for further study.

Literature review

The literature shows a longstanding interest in the differences between disciplines, and how these affect the way students and researchers use the library. A large number of approaches, methodologies, and definitions were used in order to try to understand the answer to this question. Studies have used surveys, both purpose-built (Chrzastowski & Joseph, 2006; Housewright, Schonfeld, & Wulfson, 2013) and re-analysis of pre-existing responses (Whitmire, 2002), case studies (Meyer et al., 2011; Bulger et al., 2011), or a combination of the two (Maughan, 1999) to try to understand disciplinary differences. The specific definitions of disciplines have been shaped to fit the needs of research methods or of organisational structures. For example, the case-study approach adopted by both Meyer et al. (2011) and Bulger et al. (2011) demanded an intense focus on very small and tightly-defined groups of researchers, while Housewright et al.'s 2013 survey used high-level categories to define disciplines in order to permit statistical analysis. Chrzastowski and Joseph (2006) use high-level categories in order to fit with their university's organisational structure, but Whitmire (2002) is forced to exclude the life scientists at her institution from her analysis, because the theoretical structure of the study does not allow for them. Studies have also looked at different groups of library users: undergraduates (Wells, 1996; Bridges, 2008; Cox & Jantti, 2012), postgraduates (Chrzastowski & Joseph, 2006), and researchers at all stages of their careers (Meyer et al., 2011; Bulger et al., 2011; Housewright et al., 2013; Tenopir & Volentine, 2012). Finally, they have adopted various definitions of what constitutes library use – from gate entries to e-resource usage, book borrowing to searching behaviours – to explore how different groups engage with the library and its services.

The differences in methodology and approach limit librarians' ability to make use of the findings in their own context. In some cases, findings are relatively consistent across studies: for example, arts and humanities are usually found to be the biggest users of library materials (De Jager, 2002; Maughan, 1999; Whitmore, 2002). Nackerud et al. (2013) found, at a more granular level, that College of Design undergraduates were the highest library borrowers in their study. But in other instances, different ways of defining subjects and user groups can lead to confusion in understanding exactly how findings may apply in other settings. For example, many studies found engineering students to be the least engaged library users across resources (Kramer & Kramer, 1968; Bridges, 2008; Cox & Jantti, 2012; Nackerud et al., 2013). However Chrzastowski and Joseph (2006) found that graduate students from the physical sciences and engineering used online resources more than graduates in other disciplines. This study looks at a smaller group of students (graduate students only) but across a bigger selection of disciplines (physical sciences and engineering). How is a reader to tell which change has made the difference, or whether there is something inherent to the University of Illinois at Urbana-Champaign, where their study was carried out, that is affecting the results?

In recent years, a new group of studies have begun to take a more data-driven approach to understanding library usage, deriving value from data that is routinely generated by people who use the library – gate entries or e-resource logins for example (Jisc, 2012). This data is then linked with information from student registry or central administration systems, including degree classifications, demographic characteristics, and discipline. The advantage of this methodology is

twofold. First, unlike survey or interview-based studies, it does not rely upon self-reported data to understand the phenomenon being investigated. Second, it can capture data for every student in the institution, removing the possibility of bias on the part of either the researcher or the survey respondents.

Most studies using this methodology were directed towards understanding the relationship between student library usage and degree result, usually in order to engage university management with the importance and value of the library. So, for example, Wong and Webb (2011), Cox and Jantti (2012), Stone and Ramsden (2013), and Soria, Fransen, and Nackerud (2013) have looked at various measures of library usage to understand their relationship with final degree outcome. All of these studies have demonstrated a statistically significant relationship, though they hold back from inferring what kinds of cause and effect mechanisms may be at work.

Some of these studies have begun to incorporate other variables into their work such as the demographic characteristics of library users (Stone and Collins, 2013). Other studies have looked specifically at usage by discipline. Nackerud et al. (2013) showed use by college of all types of library use, finding, for example, that 100% of pharmacy students visited the library in one semester. Nonetheless, much of this work continues to examine usage in the context of attainment. Jantti and Cox (2013) broke down their analysis by department in order to show that the science faculty got the most academic benefit from books and electronic resources, while health and behavioural sciences obtained the least academic benefit from books, and creative arts the least from electronic resources. While very informative for librarians seeking to demonstrate the impact of their work, this analysis does not provide information to identify how different groups use the library.

This study attempts to fill a hole in the literature by using routinely-generated data to understand different usage patterns across disciplines within a single institution. Studies based upon a survey methodology do not typically achieve high response rates: 14% in the case of Chrzastowski and Joseph (2006) and 7.8% in the case of Housewright et al. (2013). There can also be problems around recollection: Tenopir and Volentine (2012) deal with this through a critical incident technique which asks about the last time the respondent used the library in a particular way, but this relies upon large numbers of respondents. Case study techniques, while providing considerable depth of understanding, have similar problems around recall, and cannot always be generalised to wider communities of interest. Using routinely-generated data circumvents the problems of generalizability and recall, and presents an interesting opportunity to understand exactly how students at a particular institution use their library.

Aims

This study explores how full-time undergraduate students in a range of disciplines at the University of Huddersfield use the library and information resources. The aims are twofold: first, to explore whether routinely-generated usage data can be used to provide an insight into working patterns, and second, to analyze the different patterns of usage to inform librarian practice and the support services offered to students.

Methods

There were two sources of data for this analysis. The first was data that are routinely generated when students use Huddersfield's physical or electronic library resources, such as library gate entries, logins to e-resources, or hours spent on library computers. E-resource data do not relate to a specific resource used, but that the student logged into a database. This methodology was also used by the Minnesota study (Nackerud et al., 2013). The second were data from Huddersfield's student registry, such as

information on demographic characteristics, course and mode of study, and final degree result (where available). These datasets were amalgamated using unique identifiers and then anonymized.

Both datasets underwent considerable processing before analysis could be undertaken. Only full-time undergraduate students based at Huddersfield's main campus were included. The usage data were restructured to create new variables that permitted more sensitive analysis. For example, the data on e-resource logins were aggregated to give the hours spent logged into e-resources, counting the number of hours in a year when students logged into e-resources at least once.

The analysis method required the 105 full-time undergraduate courses offered by Huddersfield at the time of the research to be grouped into a small number of categories; ideally no more than six. Upon discussion with project stakeholders, we established that in doing this we would lose a great deal of detail and produce findings that, while useful, would be too broad an approach. To permit both rigorous analysis and useful outputs we adopted a two-tier approach; grouping courses into subject-level groups, and then aggregating these subject groups into higher-level disciplinary groupings. We could then compare subject groups within each disciplinary grouping, and also compare the disciplinary groupings for some high-level results. Note that it is not possible to compare subjects from different disciplinary groupings using the results we have provided here.

These groupings reflect the distribution of students and courses within Huddersfield and were determined by library staff. In some cases, only a top-level disciplinary grouping exists, because there is no logical way to subdivide into smaller groups – usually because Huddersfield does not offer many courses in this area. Universities wishing to replicate this study will need to identify a disciplinary structure which suits the profile of courses at their institution. Complete lists of library usage variables and their definitions are shown in Table 1. A list of disciplines and their respective student enrolment by course is shown in Table 2.

The data were analyzed using SPSS. They were tested for normality and found to be non-normal. We therefore used Kruskal-Wallis and Mann-Whitney tests to establish whether a relationship existed between discipline and the usage variables. On disciplinary groups with three or more variables, we used an initial Kruskal-Wallis test to identify whether a statistically significant difference existed followed by Mann-Whitney tests to identify which variables differed from each other. A Bonferroni correction was applied to these Mann-Whitney tests to compensate for the increased chance of Type 1 errors from multiple Mann-Whitney tests. For groups with two variables, we simply used the Mann-Whitney test.

For tests with six or more groups, we used a control group in our second stage of testing (the Mann-Whitney tests). This was to ensure we did not have an unacceptably small p value for the significance testing, following the Bonferroni correction. In each case, we selected the largest group as our control, in order to identify differences from the majority which might not be noticed by librarians in their day-to-day work. At the disciplinary level, social sciences was selected as the control as it was the largest group (contained the highest number of students). There was no need to use a control group for any of the subject-level analysis as these all contained five or fewer groups.

Throughout our analysis, we have followed Cohen (1992) in classifying effect sizes:

.1 – small effect
.3 – medium effect
.5 – large effect

Table 1
Library Usage Definitions

Variable	**Definition**
Number of items borrowed	Items checked out from the library; not limited to books
Number of library visits	Measured via gate entries – all students must swipe their ID card to enter the library, this data is recorded on library systems
Hours logged into library PC	Number of hours in a year in which a student was logged into a library PC (maximum possible number of PC hours per year is 8, 760 = 24 hours x 365 days). Multiple logins within a single hour on a single day are not counted
Hours logged into e-resources	Number of hours in a year in which a student was logged into e-resources, both on-site and remote logins (maximum possible number of e-resource hours per year is 8,760 = 24 hours x 365 days). Multiple logins within a single hour on a single day are not counted
Number of PDF downloads	
Total number of e-resources accessed	The number of different e-resources accessed both on-site and through remote logins. Within Huddersfield's data, a single e-resource varies from an individual journal subscription to a large multi-journal platform or database, so this data must be treated with some caution
Number of e-resources accessed 5 or more times	
Number of e-resources accessed 25 or more times	

Results

Table 3 shows the median values for each measure of library usage at the discipline level. Table 4 shows the effect sizes, in a range from 0 to 1, and the statistical significance of Mann-Whitney tests on each measure when comparing the discipline to the control group of social sciences. Social sciences has been used as a control because it is the largest disciplinary group (containing the highest number of students). A light grey cell indicates that usage in the group under examination was lower than in the control group of social sciences, while a darker grey cell indicates that it was higher than the control group. Cells that have no highlighting indicate no significant difference between the group and the control group. All results are significant at the .005 level, which is the value generated by the Bonferroni correction for a .05 significance level.

Table 4 shows that students within the social science grouping are, in most respects, significantly higher users of library content and resources than any other disciplinary grouping. Arts students are the lowest users, with a large effect size for the number of PDF downloads, and medium effect sizes for most of the variables associated with e-resource use. The courses which make up arts disciplines may explain this lower level of usage. Many of them rely upon visual or audio content rather than the journal articles available via Huddersfield's e-resources.

Tables 5 and 6 show the breakdown of the arts group in more detail. In this case, we compared all of the groups against each other, so Table 6 is

Table 2
Course Enrolment

Discipline	**Subject**	**Number of students**
Science	Science	30
	Discipline total	*30*
Health	Health	138
	Discipline total	*138*
Computing and engineering	Computing	74
	Engineering	43
	Discipline total	*257*
Arts	Music	74
	Architecture	59
	Fashion	130
	2D Design	29
	3D Design	47
	Discipline total	*339*
Humanities	English	70
	Drama	41
	Media and Journalism	111
	Discipline total	*222*
Social sciences	Business, management and accountancy	352
	Law	60
	Behavioural sciences	236
	Social work	85
	Education	70
	Discipline total	*803*

Table 3
Median Values for Library Usage Measures, by Discipline

Library usage measure	Number of items borrowed	Number of library visits	Hours logged into library PC	Hours logged into e-resources	Number of PDF downloads	Number of e-resources	Number of e-resources accessed 5 or	Number of e-resources accessed 25 or more times
Science	14.0	180.5	11.5	16.0	32.0	11.0	1.5	0.0
Computing and engineering	10.0	48.0	4.0	6.0	10.0	6.0	0.0	0.0
Arts	29.0	132.0	18.0	5.0	1.0	5.0	0.0	0.0
Humanities	43.0	116.5	16.0	28.5	46.0	14.0	3.0	0.0
Health	57.5	111.5	13.0	47.0	111.5	26.5	6.0	0.0
Social sciences	43.0	112.0	16.0	26.0	47.0	14.0	2.0	0.0

Table 4
Effect Sizes and Statistical Significance of Mann-Whitney Tests by Discipline

Library usage measure	Number of items borrowed	Number of library visits	Hours logged into library PC	Hours logged into e-resources	Number of PDF downloads	Number of e-resources accessed	Number of e-resources accessed 5 or more times	Number of e-resources accessed 25 or more times
Science	.232							
Computing and engineering	.337	.214	.106		.283	.281	.272	.157
Arts	.193			.435	.559	.485	.432	.183
Humanities		.113	.064		.138			.087
Health	.064	.295	.147		.057	.114		.147

slightly more complex. The top line shows the two groups that we are comparing, and the letter in the cell indicates which group was higher as per the key below the figure. As before, a blank cell indicates no significant difference between the two groups. All results are significant at the .001 level, which is the value generated by the Bonferroni correction for a .05 significance level.

Clearly, music dominates usage against all other subjects on a number of variables and, in relation to the number of items borrowed, with a large effect size. This may be because the music subject group includes some courses that might have fitted alongside English or drama in the humanities group, as well as some that are more technology-focused and rightly belong in the arts group. It is also worth noting that fashion students visit the library frequently; this may be because they are making extensive use of the art and design resource area which has traditionally been strong in their discipline. Architects have a separate resource area outside the library, which may explain their lower levels of usage. We found no statistically significant differences in usage when comparing 2D design with fashion and with 3D design.

Table 7 shows the breakdown for subject groups within the social science discipline, and table 8 shows the results of the statistical tests. Again, all the groups are compared with each other. All results are significant at the .001 level, which is the value generated by the Bonferroni correction for a .05 significance level.

Many of the effect sizes in this group are large, indicating very different patterns of usage between subjects. Overall, students in behavioural sciences tend to show the highest usage on most measures, when compared to other subjects. Business students have higher usage than law, social work, and education students on several dimensions but not on the number of items borrowed, which is consistently lower (and with a large effect size). Lawyers are extremely low users of library resources, particularly e-resources; we hypothesize that this may be because, more than any other discipline, they rely upon a few core texts which

they purchase for themselves. We observed no difference in usage for social work and

Table 5

Median values for Library Usage Measures for Arts Discipline, by Subject

Library usage measure	Number of items borrowed	Number of library visits	Hours logged into library PC	Hours logged into e-resources	Number of PDF downloads	Number of e-resources accessed	Number of e-resources accessed 5 or more times	Number of e-resources accessed 25 or more times
Music	107.0	162.0	10.5	17.5	5.0	8.0	1.0	0.0
Architecture	26.0	81.0	21.0	12.0	18.0	10.0	1.0	0.0
Fashion and textiles	21.0	124.5	18.0	2.0	0.0	2.0	0.0	0.0
2D design	2.0	162.0	42.0	4.0	0.0	2.0	0.0	0.0
3D design	43.0	164.0	18.0	8.0	1.0	5.0	0.0	0.0

Table 6

Effect Sizes and Statistical Significance of Mann-Whitney Tests in Arts Discipline, by Subject*

Library usage measure	Number of items borrowed	Number of library visits	Hours logged into library PC	Hours logged into e-resources	Number of PDF downloads	Number of e-resources accessed	Number of e-resources accessed 5 or more times	Number of e-resources accessed 25 or more times
Music /Architecture	.646 (M)	.434 (M)		.300 (M)			.322 (M)	.256 (M)
Music /Fashion	.524 (M)				.315 (M)	.292 (M)	.248 (M)	
Music /2D design	.621 (M)			.361 (M)	.293 (M)	.322 (M)	.401 (M)	.363 (M)
Music /3D design	.676 (M)		.280 (3D)	.430 (M)	.488 (M)	.427 (M)	.428 (M)	.316 (M)
Architecture /Fashion		.352 (F)						
Architecture /2D design		.328 (2D)						
Architecture /3D design					.324 (3D)	.299 (3D)		
Fashion /3D design		.363 (F)						

*Music (M); Architecture (A); Fashion (F); 2D Design (2D); 3D Design (3D)

Table 7
Median Values for Library Usage Measures for Social Sciences Discipline, by Subject

Library usage measure	Number of items borrowed	Number of library visits	Hours logged into library PC	Hours logged into e-resources	Number of PDF downloads	Number of e-resources accessed	Number of e-resources accessed 5 or	Number of e-resources accessed 25 or more times
Business	26.0	113.0	17.0	33.0	74.5	13.5	3.0	0.0
Law	24.0	159.5	25.5	0.0	0.0	0.0	0.0	0.0
Behavioural sciences	89.0	132.5	22.0	34.5	74.0	18.0	3.0	0.0
Social work	81.0	74.0	8.0	18.0	29.0	16.0	1.0	0.0
Education	72.0	76.5	4.0	21.0	42.0	17.0	2.0	0.0

Table 8
Effect Sizes and Statistical Significance of Mann-Whitney Tests in Social Sciences Discipline, by Subject*

Library usage measure	Number of items borrowed	Number of library visits	Hours logged into library PC	Hours logged into e-resources	Number of PDF downloads	Number of e-resources accessed	Number of e-resources accessed 5 or	Number of e-resources accessed 25 or more times
Business /Law				.477 (B)	.456 (B)	.459 (B)	.421 (B)	.200 (B)
Business /Behavioural sciences	.590 (BS)					.175 (BS)		
Business /Social work	.409 (SW)	.264 (B)	.185 (B)	.155 (B)	.168 (B)		.139 (B)	
Business /Education	.405 (E)	.154 (B)	.177 (B)					
Law /Behavioural sciences	.537 (BS)			.573 (BS)	.549 (BS)	.576 (BS)	.477 (BS)	.188 (BS)
Law /Social work	.642 (SW)	.354 (L)	.265 (L)	.636 (SW)	.626 (SW)	.679 (SW)	.565 (SW)	.257 (SW)
Law /Education	.715 (E)		.276 (L)	.744 (E)	.713 (E)	.775 (E)	.724 (E)	.358 (E)
Behavioural sciences/Ssocial work		.358 (BS)	.220 (BS)					
Behavioural sciences /Education		.213 (BS)	.219 (BS)					

*Business (B); Law (L); Behavioural Sciences (BS); Social Work (SW); Education (E)

education, which may reflect a similarity in how these two groups of vocational courses are taught.

The computing and engineering subgroups had very few differences between them. Computing students were more likely to visit the library (median = 61.0, r=.362) and spent more hours logged into the library PCs (median = 8.0, r=.235). We think that this may be because computing students are more likely to use their own personal computing equipment, compared to the engineers.

Among the humanities subgroups, there were no statistically significant differences in usage between students on the English and drama courses. However, both groups showed higher levels of usage than media students on most of the e-resource dimensions, English students with slightly bigger effect sizes. This probably reflects the way that the courses are taught, and in particular the importance of written texts and criticisms to English and drama students.

Discussion

Our results demonstrate the value of a data-driven approach for librarians seeking to understand usage patterns among library users from different disciplines. Comparing our findings to previous studies, several disparities appear. Arts and humanities students are not particularly heavy library users, as they have been found to be in earlier work (De Jager, 2002; Nackerud et al., 2013; Maughan, 1999); in fact, they are lower users than social scientists on most dimensions. Earlier research found computing and engineering students to be relatively low users of library resources (Kramer & Kramer, 1968; Bridges, 2008; Cox & Jantti, 2012; Nackerud et al., 2013), although Chrzastowski and Joseph (2006) found that graduate students from the physical sciences and engineering used online resources more than graduates in other disciplines. Again, our results show that although students from the computing and engineering discipline are low users (relative to the control group of social sciences), they are not particularly different from some other disciplines, such as arts, in this respect.

This study was also able to show quite nuanced differences in library usage within the high-level subject groupings. This information, for example – showing the high usage level of musicians compared to other "arts" subjects, or the strong usage by behavioural scientists compared to other social science groupings – helps librarians develop a more realistic understanding of how students use resources and to target areas of particularly low uptake which may be masked by the behaviour of bigger groups within a subject. This is a distinct advantage of this methodology over earlier survey-based methodologies, where response numbers were too small to permit statistical analysis at this level of granularity.

Findings from this phase of LIDP regarding subject disciplines gives the library evidence that a one size fits all approach, such as information literacy sessions could be enhanced by intelligence from library analytics. For example, known "low-use" subjects could be targeted differently from known "high use" subjects in order to give a more personalized boutique service to the end user. This addresses one of Tilley's (2013) success factors of the boutique model, "[k]nowledge of users' needs and activity-their preferences, the irritants-and their methods of working" (p.82). However, using library analytics and making the assumption that increased use of library resources may lead to increased achievement, knowledge of subject cohorts methods of working could be used to guide them to appropriate resources.

Of course, this methodology retains some limitations. The usage measures are very accurate representations of student behaviour but we must be cautious about how we interpret them. For example, we cannot claim that students only entered the library in order to study, as other student services were also located there at the time of the study; gate entries recorded by library systems might represent students seeking help with issues completely outside the library. Interestingly, previous research indicated that gate entries are one of the library usage measures that are not correlated with student outcomes (Stone & Ramsden, 2013).

We must also be cautious about over-interpreting why usage patterns look the way they do. Qualitative methodologies are more useful in understanding this kind of issue. Face to face discussions with the cohort provides a much richer seam of information. Tilley explores this in her discussion on the knowledge about English students at the University of Cambridge and the implications for the library service. But library analytics can help to identify the "context" that Tilley (2013) describes, which, "… allows us to prioritize areas of our service for improvement" (p. 91). This is also supported by Poll (2012) who suggests a mixed methods approach as the most effective way of exploring library impact. At Huddersfield, this mixed methods approach has been adopted and used to support the findings of the LIDP. Towards the end of the study, a focus group was held with a cohort of computing students – a cohort that had been identified as low users in the study. This proved valuable as a way to evidence the data from the project in a real life situation, where students could explain their reasons for library use. As Tilley (2013) states, this should not be a one off conversation, but the beginning of frequent knowledge collection.

There have also been two spin off projects at Huddersfield that were heavily influenced by the study. The first is the 'Roving Librarian' project, which was being piloted at the time of the study, and was continued using the findings of LIDP in order to target areas of low use. "The statistics gathered showed that many students are not using our resources…" Therefore the Roving Librarian project extended its roving "… to take it to social spaces and resource centers within all schools to reach students who may otherwise be library non-users." (Sharman & Walsh, 2012) The other project to come out of LIDP was Lemontree (Running in the Halls, 2012), which was designed to be a fun, innovative, low input way of engaging students through new technologies and increasing use of library resources. When registering for Lemontree, students sign terms and conditions that allow their student number to be passed to Computing and Library Services (CLS), which allows CLS to track usage of library resources by Lemontree gamers versus students who do not take part. This study only planned to come up with a proof of concept, however, over 850 users registered by October 2012, thus providing a solid base for further analysis in order to establish whether intervention using gamification can have an impact throughout a student's academic course. Since completion of the study, Lemontree, now known as Librarygame (Running in the Halls, 2013), is being used by the universities of Huddersfield, Glasgow, and Manchester.

Just as this study identifies findings that contradict earlier research, we would not expect that the findings at Huddersfield will necessarily translate into other institutions. The subject groupings reflect Huddersfield's structure and strengths, and may not be typical of other universities in the U.K., let alone in the wider higher education sector. The specificity which makes our findings so useful at Huddersfield make them much less useful to other institutions, and mean that it can be rather difficult to benchmark the library's strengths and weaknesses against comparable institutions, or to aggregate data to get a better picture of usage patterns across institutions (a strength of the first phase of the work, which worked with eight institutions altogether) (Stone & Ramsden,

2013). With this in mind, towards the end of the study, the project collaborated with colleagues at Mimas (2013) to produce a library analytics survey in order to assess the demand for a national library analytics tool. The survey found that 94.6% of those who replied wanted to benchmark their data with other institutions and that 87.7% were interested in the richer data that was used as part of this study (Showers & Stone, 2014). As a result of the LIDP findings and the LIDP-Copac survey, Jisc have commissioned a new project, the Library Analytics and Metrics Project (JiscLAMP), which in 2013 produced, "a prototype shared library analytics service for U.K. academic libraries" (Jisc, 2013).

Conclusions

This study examined whether large datasets could be used to understand disciplinary differences in student library usage. It used statistical analysis to explore routinely-generated data from the University of Huddersfield's library, linked to information about students from the student registry.

This technique revealed significant differences among groups of students and found that these differences were not always the same as those identified by previous studies. In doing so, it demonstrated the value of undertaking this analysis on an institution-by-institution basis in order to avoid developing services based upon information from other universities or studies which may not reflect usage patterns across all institutions.

Unlike more qualitative methods, the technique is unable to say much about why these different usage patterns exist. However, findings could be followed up with focus groups or interviews with the groups of students in question, in order to gain a greater depth of understanding.

The Jisc-funded (2013) Library Analytics and Metrics Project (LAMP) is an interesting attempt to automate this analytics service for libraries that are able to supply the relevant data; it also offers opportunities to develop standardised definitions for subject, ethnicity, country of residence, and other demographic variables so that they can analyse their data on their own terms or compare it against other institutions. In 2014 LAMP produced an "ugly prototype", which was able to manipulate the raw data from this study and other partner institutions (Showers, Palmer & Stone, 2014). LAMP has now received additional funding to produce a shared service for the U.K., which will enable libraries to submit their own data for analysis, which will include statistical significance testing. This will allow follow up research to be conducted by libraries that join the service.

Both phases of the LIDP have produced toolkits to aid institutions wishing to collect and analyze their own data (Stone and Collins, 2012; Stone, Ramsden & Pattern, 2011), in addition a value impact starter kit (Oakleaf, 2012) comprising 52 exercises for librarians, an outcome of the value of academic libraries project (Oakleaf, 2010), is also available. The LAMP project is also considering a toolkit approach in order to address concern over the level of statistical knowledge required by users in order to interpret the outputs of the system. One possible outcome would be to collaborate with Oakleaf on a new toolkit and initial discussions are underway.

At the University of Huddersfield, discussions are now underway to consider how the results of the study can be used to improve the student experience. Now that the library can evidence the results of the study, a set of briefing papers are planned for specific subject areas that shows the evidence in areas that relate specifically to academic staff - it was decided at an early stage that low usage is not acceptable in any discipline. Furthermore, longitudinal data is required to look at usage over time so that the library can start to benchmark and show whether interventions have made a difference.

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