Following the arc of learning: Using syllabi to target instruction in a professional graduate program

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ABSTRACT

This study examines a corpus of syllabi to target program-specific information literacy needs. Examining a graduate program in Urban Planning, the study first identifies specific information literacy needs for the program, focusing on student data use, student tasks including locating, identifying and analyzing existing data sets. Based on these needs, the study then analyzes all courses in the curriculum, identifying places in the curriculum that strongly feature student data use and identifying patterns among those courses. What emerges is the 'Arc of Learning', a sloped trajectory that takes students from dependent beginners to independent pre-professionals. By following this arc, librarians can better make the case for library instruction in the curriculum. This study additionally provides a framework for such a study.

Introduction

There are many obstacles to incorporate specialized library instruction into the graduate curriculum. Students in professional graduate programs often have very different needs than the general library population, but it takes significant amounts of work to identify those needs and find a way to meet them. The liaison librarian to a graduate college rarely benefits from curricular arrangements that help the general student population. While many colleges and universities have undergraduate introductory writing courses with established library coordination and individual instructors opt to incorporate project-based library instruction in specific courses, established graduate programs do not often have library instruction included by departmental mandate.

To address this problem, a liaison librarian is forced to find their own entry point into the curriculum, analyzing both the information literacy needs of students within the program and finding the best opportunities for information literacy education. The results of such an analysis can aid the liaison librarian in finding the place for information literacy instruction in a specialized program as well as finding a way to show faculty how information literacy instruction fits into larger educational goals. However, doing so on an ad hoc basis can be time consuming and leave gaps in coverage.

One highly effective way to avoid these gaps is to conduct a systematic syllabus study. Examining the body of syllabi alongside supporting information can give a sense of the trajectory of education, the needs of students and the goals of a graduate program. Beyond increased awareness, this information can be used to design useful tools, better communicate with departmental faculty, and form the basis for

inclusion of information literacy instruction in the curriculum. To achieve this, this study examines the syllabi of a Masters' program in Urban Planning and Policy to determine how to identify the Arc of Learning and identify the place in the curriculum when targeted information literacy instruction could be best incorporated and lays out a set of steps to duplicate the process.

Literature review

Syllabus studies have been part of the library research toolbox for over 30 years and have examined a broad range of questions. These questions, while varying in specifics, tend to fall into three categories: First, general inquiries into the uses of syllabi, second, specific discipline studies that examine syllabi within specific academic disciplines, third, strategic studies, evaluations of potential actions based on syllabus study. Understanding these different approaches and their results will help to establish what questions syllabus studies can answer and help guide a methodology to address the question of information literacy instruction in the graduate curriculum.

The first type, general inquiries, include studies that set up the basics of what a syllabus study can do, illustrating that the examination of syllabi can be useful for library strategy. These studies include Linda Rambler's pioneering 1982 work (Rambler, 1982), which introduced the syllabus study to the library science literature and the 1989 comparative study by Lauer, Merz and Craig, which compared two institutions to analyze assigned library use within the curricula (Lauer, Merz, & Craig, 1989). These initial studies established the principle that course syllabi could be used to help guide academic library decision

making.

Others have done general inquiry studies to explore the limitations of prior syllabus studies such as VanScoy and Oakleaf's 2008 study, which identified that "Many early syllabus studies focus on how much students are required to use the library, rather than examining the information literacy skills they need to accomplish their course assignments." (568) (VanScoy & Oakleaf, 2008) VanScoy and Oakleaf identify several types of information that students are called upon to access in courses and used that information to design instruction sessions that prioritize those information literacy skills. Overall, general inquiry studies establish clearly that the syllabus study can answer questions on scale of student library use and can be used to identify specific information literacy skills required in courses.

The second variety of syllabus study, the specific discipline study, narrows their focus to subject-based curriculum. By exploring the syllabi of a discipline, librarians can understand the research needs within that discipline. A notable example of this sort of study by Nancy H. Dewald examines expectations of library use within the business curriculum. As Dewald puts it, "Librarians can be most effective when they know what those requirements are in order to be ready to respond to student needs and in order to initiate dialogue with faculty about their expectations for student research." (33) (Dewald, 2003) Dewald's study found that the needs of business students were well delineated in their course syllabi and that librarians could use those syllabi to better understand how those needs might differ from other populations. Several other studies follow similar models, such as Dinkelman's study of the biology curriculum (Dinkelman, 2010), and Alcock and Rose's comparison between history and chemistry curricula (Alcock & Rose, 2016). Maybee, Carlson, Slebodnik and Chapman took an even broader comparative approach, looking at Nutrition Science and Political Science syllabi and comparing undergraduate and graduate programs. In their research, they identified programmatic themes that emerge from the syllabi (Maybee, Carlson, Slebodnik, & Chapman, 2015). Overall, specific discipline studies found that syllabi could be used for the exploration of needs specific to disciplines, answering direct questions about particular disciplinary information literacy needs.

The final type of syllabus study, the strategic study, uses the study of syllabi to help guide decisions in library instruction. These look at how syllabi can guide the process of achieving instructional goals. Williams, Cody and Parnell looked at this process in their 2004 study, examining newly available online syllabi to help develop a web-based resource portal targeted to individual classes (Williams, Cody, & Parnell, 2004). A similar approach was present in a 2012 study by Smith, Doversberger, Jones, Ladwig, Parker, and Pietraszewski which looked comparatively at syllabi at the University of Notre Dame with the goal of increasing library involvement.

A key to effective course integrated instruction is identifying appropriate courses where academic librarians can collaborate with faculty to teach information literacy. While formal in-class library instruction is ideal, there are other less formal ways to work with faculty to embed library resources into courses to improve the information literacy skills. These include the creation of pathfinders, bibliographies, webliographies, guides to the literature, and course guides. These tools can also be integrated into the university's courseware to provide more customized library research assistance, serving as a way of getting a toe in the door of classes for which there was not previously any library instruction.(264) (Smith et al., 2012).

This method of targeted integration was echoed in a 2014 article by Boss and Drabinski which used syllabi to target library instruction "The syllabus study generated evidence that the librarians are using to strategically expand information literacy instruction in accordance with our instruction roadmap" (273) (Boss & Drabinski, 2014). Overall, this variety of study shows that syllabus study can help target instruction and increase the integration of the library into the curriculum.

Based on the review of existing syllabus studies, there are a number of promising research opportunities available from syllabus study.

These can be summarized in three relevant assertions that guide the development of methodology and the framing of the research questions.

1. Examining syllabi allows the exploration of library needs for individual courses.
2. Comparative examination of syllabi within a program can establish student needs within the specified program.
3. Understanding these student needs can help librarians better tailor instruction both in and out of the classroom and open doors for outreach.

Based on these assertions, examining a group of syllabi within a program to understand information literacy needs is a valid approach to tailor instruction strategy.

Methods

The process of analyzing syllabi for a syllabus project was broken into multiple steps for this project. Rather than treat the process as a single task, the process can be seen as six different consecutive tasks that feed into each other. None of these tasks really stand on their own and the process of completing each one shapes the next, but this forms a basic template of the approach to a specialized syllabus study.

1. Gather syllabi
2. Read over syllabi to identify points of interest
3. Create rubric
4. Analyze individual syllabi
5. Calculate totals
6. Analyze patterns

Gather syllabi

The first step is of course to gather syllabi, and part of that involves considering the nature of the program to determine what needs to be collected and how. It is worth considering what courses are available and required. The primary object of this study, the Masters in Urban Planning and Policy from the University of Illinois at Chicago's Center for Urban Planning and Public Affairs, had a number of criteria and characteristics that influenced this step. First, while the Masters' program is not the only degree in Urban Planning, it is the primary professional degree, with the PhD being primarily a teaching degree, so the decision was made to examine the needs of that program specifically. Second, the MUPP degree has a highly structured 2 year timeline. This means that essential courses are offered every other year to accommodate alternating cohorts. Third, and most conveniently for this study, the program has a requirement that all course syllabi be posted on the college's website.

Based on these characteristics, all syllabi were collected from a two year period as a representative sample. To avoid overcounting multi-section courses, since students would only take a specific course once, duplicate courses with the same syllabus, generally by the same instructor, were removed from the sample. Courses that had the same course number but different syllabi, generally topics courses with different subject matter, were retained. Altogether, this added up to 61 syllabi for analysis.

Read over syllabi to identify points of interest

The second step once the syllabi are gathered is to do content analysis. By reviewing the individual syllabi, the librarian can identify relevant aspects within the corpus of syllabi. The main thing to look for is specific information literacy tasks or skills, sections of the course that overlap with aspects of the ACRL framework or similar tools for evaluating student library use.

In this study, individual syllabi were examined for these information

Category	Question	Yes	No
Learning Objectives	Were there mentions in course objectives that explicitly or implicitly required Student Data Use?	1	0
Final Project	Were there mentions in a final project description that explicitly or implicitly required Student Data Use?	1	0
Other Projects	Were there mentions in other class projects that explicitly or implicitly required Student Data Use?	1	0
Other Syllabus Mentions	Were there mentions elsewhere in the syllabus that explicitly or implicitly required Student Data Use?	1	0

Fig. 1. Demonstration of coding and markup.

literacy tasks and skills and several aspects stood out as distinctive programmatic needs. Primary among these was the focus on 'student data use'. In many courses, students were required to locate and utilize urban planning data, a task that linked to several aspects of the ACRL framework, research as inquiry and searching as strategic exploration most directly. The tasks which required the use of data often required the development of research strategies and the use of expert search techniques using library managed resources. These tasks appeared to be prime candidates for library instruction sessions.

In doing this analysis for a professional program, it is also worth considering the influence of professional standards on graduate education. The requirement for student data use correlates directly with the requirements of the Planning Accreditation Board for graduate education. Part of the standards and criteria is a list of 'Required Skills Knowledges and Values of the Profession,' which details required material for a graduate curriculum. Listed among the planning skills was the following requirement. "2c) Quantitative and Qualitative Methods: data collection, analysis and modeling tools for forecasting, policy analysis, and design of projects and plans (Planning Accreditation Board, 2017)." This goal thus aligned not only within the internal needs, but with external criteria.

Create rubric

Once the points of interest are identified, the syllabi can be examined for sections where these tasks or skills frequently appear. This process can be used to create a rubric for analysis. Syllabi are often written to templates, with specific sections that repeat from syllabus to syllabus. This can allow the development of specific analytical categories for comparison among syllabi. This is important to insure that comparisons are done fairly and evaluated against each other in a way that supports analysis. This improves the reliability of the analysis, minimizing subjectivity in analysis.

The syllabi from the Urban Planning and Policy program varied widely in the number of mentions of student data use, but general analysis showed that there were several sections that frequently featured these references in a way that suggested comparisons. These sections formed the basis of the evaluation rubric. The rubric judged presence or absence of student data use content in each of these sections to represent the role data played in an individual course. Measuring presence or absence as a binary state further reduced issues of subjectivity in analysis.

The first section was simple, course objectives were present in each course and often featured mentions of student data use. The second and third were based on assignments included or mentioned in the syllabus. Reading over syllabus content showed a major difference between courses that had data use in both initial assignments and in a final project, so these were broken into two separate sections of the rubric.

The final section gathered in mentions that did not occur in the other evaluated parts of the syllabus. These mentions appeared in a number of different parts of the syllabus, mentions in class session descriptions or course descriptions or required software packages. These mentions were grouped together to avoid cluttering the data with too many different categories, many of which did not appear in all syllabi.

In the end, the rubric looked like the one listed in Fig. 1, with four points of evaluation. This rubric was applied to the full selection of syllabi, which were examined in the next step of the process, analyzing individual syllabi.

Analyze individual syllabi

The next step in the process is to systematically analyze each individual syllabus based on the criteria in the rubric. For this process, one of the complications comes in the recognition of specific mentions. Content analysis can be subjective, so it is best to create standards for what is considered a positive mention in a given category. This ensures a degree of consistency, but does require an additional level of analysis.

The first criteria of the rubric referred to learning objectives, which were one of the most direct aspects of the syllabus to judge. Most syllabi included learning objectives and among many of those were specific objectives about data literacy and/or finding data sources. Phrases such as "Review of data sources required for effective business corridor planning." [535][1] or "Data used in transportation planning" [560] appeared in some course objectives, explicitly referencing specific data literacies, while other objectives provided more holistic goals such as "Identify and use data sources and apply quantitative reasoning to analyze and present data, as well as to use less traditional sources such as case studies and interviews." [575] or "To extend those concepts by introducing the basic techniques of applied urban analysis, including the collection, cleaning, manipulation and analysis of data for local areas." [405]. These mentions gestured directly toward the requirements for student data use in the course.

Not all mentions were explicit, so objectives that strongly implied an approach to data were counted as positive mentions. Course objectives with wording like "Be able to apply quantitative reasoning and appropriate analysis techniques to problem identification, detailing alternatives and selecting among alternatives." [506] and "Know about frameworks for assessing urban food systems." [493] were considered in terms of student data use requirements. These and similar objectives were evaluated broadly as relevant to student data use when compared with other course objectives such as "Students will improve their ability to speak intelligently about planning and design in public." [460] or "Demonstrate knowledge of democratic governance and activity and how these shape roles and practice of planning." [501] that did not

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[1] Numbers in brackets represent the course number of the syllabus being quoted

imply student data use. Based on these criteria, 23 out of 61 courses were judged to have implicit or explicit mentions of student data use in their learning objectives.

For the next two criteria, syllabi were examined for whether student data use appeared in assignments. In a statistics heavy discipline like urban planning, student data use was found to be a common but not universal feature of assigned work, with 42 out of 61 syllabi requiring data use in the context of an assignment. More detailed examinations showed several relevant distinctions. In the analysis, some assignments were more explicit in framing data use, but implicit mentions were also included. In assignments with explicit uses, phrases were used that left no ambiguity over whether data would be used. For example, this sample from an intro graduate course.

For this part of the assignment you must use BOTH words (be concise) and visual aids, which can include tables, graphs, pictures (photos you take or download, other images), maps, etc. This means you will need to collect and analyze data on people and "things" in the space you are investigating. Quantitative data will most likely include US Census (current and historical) but is not limited to this. You may also want to include data you collect yourself (e.g., count of how many people utilize the community park on a Saturday) or get from other sources (e.g., the number of building permits issued for the community in 2010). It is good to start by thinking about what you need to know first and then decide what data you would like to include and where and how you will get that data. [501]

Other assignments detailed in syllabi included similar, though less extensive language. In one upper level course on developing housing plans, an assignment included "Objectives: To increase your knowledge and skills for developing a housing plan, particularly 1) assembling, analyzing and presenting data [542]". These explicit mentions were easy to recognize as examples of student data use.

Some assignments only implied that data would be required. In these assignments, while data was necessary to assignment requirements, it wasn't mentioned directly. For example, the following final paper assignment for one class includes the following language

As an extension of class discussion topics, students will explore a specific environmental planning issue of interest, develop a 15-page double-spaced paper…and summarize it in a 20-minute presentation. An integrated view of economic, environmental, and social principles is encouraged in the final project. [570]

In this example, the assignment does not explicitly specify that data must be found and used. However, any examination of economic impacts of planning would require quantitative economic data, examinations of environmental impacts of planning would require any or all of geological, climatological, geospatial and meteorological data, and even examinations of social impacts of planning would require the use of demographic data. While the assignment itself does not say 'find and use data', the end results are impossible without that acquisition. These mentions skipped over the step of telling students to find data, but finding data was still required. Based on the functional similarity between these two, explicit and implicit data use requirements were both counted as positive examples of student data use.

These two sections of the rubric were examined using the same standards for the different types of assignment. Final projects with student data use were present in 40 out of 61 syllabi, and non-final assignments with student data use were present in 19 out of 61.

The final aspect of the rubric involved general analysis of the syllabus for mentions outside of the prior sections in the rubric. Some of these came in sections too small to include as their own separate rubric section, some came in isolated but noteworthy sections. In analysis, these were grouped together to indicate the additional focus while not

overcounting the mentions by splitting them into multiple individual categories.

One area that frequently mentioned student data use was the course description. Generally at the beginning of the syllabus, the course description gave a sense of the overall direction of a course and in many cases included explicit reference to student data use. For instance, the following description was clear about the role of data analysis, a variety of student data use, in the class.

This course introduces students to the basic concepts related to social science research and associated data analysis techniques. Topics to be covered include: research design, presentation of data, descriptive statistics for cross-sectional, time-series and spatial data, bi-variate and multi-variate analysis (as they relates to the examination of causality), probability concepts, sampling, hypothesis testing and confidence intervals, and linear regression. Students will also learn to use the computer packages to clean, manage, analyze, and present data. [510]

Other descriptions include language directed at specific programs that require data for use, such as SPSS, Excel or ArcGIS, e.g. "Primarily, this course is about learning ArcGIS Desktop, although we will explore a range of GIS issues along the way." [461] or "Students will have basic to intermediate skills in the software applications covered by the course: Adobe Creative Suite (Illustrator, Photoshop, InDesign); Google Sketchup, Earth; MS Excel; and ArcGIS". [460].

Another part of the syllabus that frequently featured mentions were specialized class sessions on data topics or relevant computer programs. Syllabi include specific class sessions on a number of data related topics including "Excel Tricks for GIS" [460] "Research Design and Data Collection -process of research design - primary data collection" [502] and "Using American Factfinder & Census TIGER site" [460]. These class sessions focused directly on data heavy programs or data literacy skill development and were counted as uncategorized mentions.

Altogether, these uncategorized mentions added up to 27 positives out of 61 syllabi. With this final category evaluated, each syllabus had positive or null rating in each individual category of the rubric. This allowed the next step, calculating totals.

Calculate totals

With each individual course analyzed, the next step is to assemble each of the different parts of the rubric into a rating for the course. By adding up the rubrics, courses will gain ratings that allow for comparison of totals between the different syllabi. A course with a high rating indicates a higher presence of specific subject content being analyzed within the project.

For this project, all syllabi were given a data pervasiveness rating between 0 and 4 based on the assessment in the rubric. These totals represented the levels of "data pervasiveness" for an individual course, how many different parts of the course featured a requirement for student data use. In this, a course at 0 featured no requirement of student data use and a course of 4 featured requirements for student data use in all four different evaluated sections of the syllabus. In order to achieve a rating of 3, a course would have to have student data use in at least three separate categories, indicating that students would at least have to grapple with data in one assignment and also in things like a course objective and a specialized class session. This comparative calculation allowed for direct quantitative comparison between syllabi, distinguishing between syllabi that featured extensive requirements for data from those that featured minimal direct mentions of student data use. With this object for comparison in place, it was possible to analyze the entire corpus of syllabi for patterns.
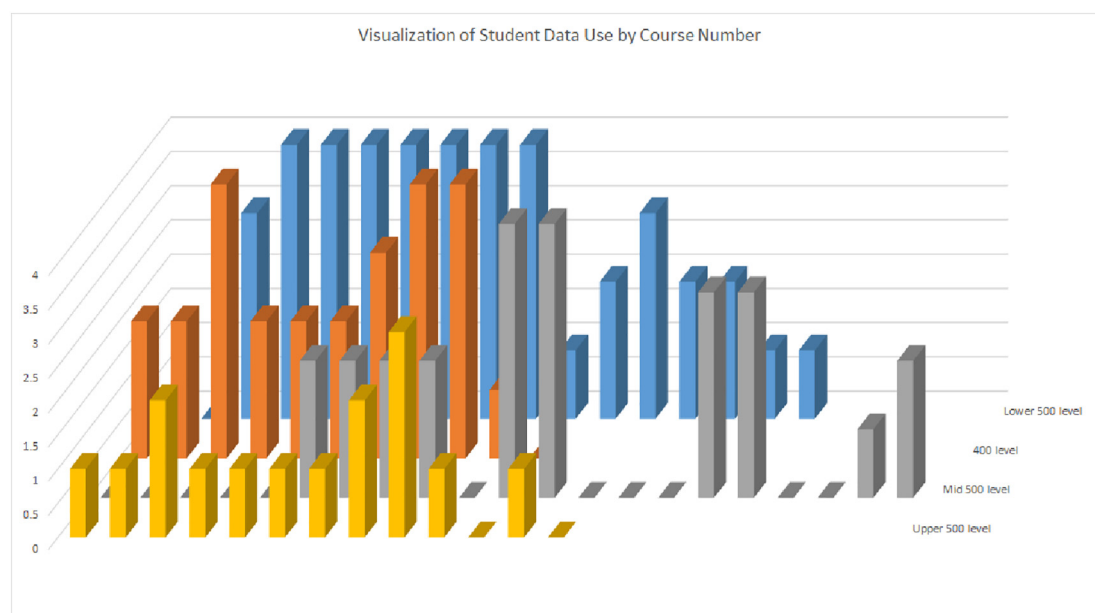
Fig. 2. A visualization of student data use by course range.

Analyze patterns

The final step in the process is the analysis of the general corpus that allows for the examination of the program as a whole. While the results of this process are discussed in the findings section below, there are some important aspects to consider in the analytical pattern process. For instance, one useful metric for study may be the timeline of the degree, how syllabi fit into the overall order of classes a sample student would take. This analysis may require gathering data from the program or the university about how different syllabi fit together. Additionally, understanding how specific courses require specific prerequisites can allow better sorting of courses into categories, allowing comparison not just of specific courses, but comparisons between general categories of courses.

When it came to analyzing syllabi for patterns in the Urban Planning Curriculum, observations were based on a number of characteristics. Syllabi were divided into four roughly equal sections based on their position in the course career of a graduate student and whether they had prerequisites. This led to four different categories, the lower 500 category were mainly mandatory introductory courses required during the first two semesters. The 400 level category were hybrid graduate/ undergraduate courses without prerequisites, generally electives on specific topics of interest. The Mid 500 Level category was made up of courses split up by specializations with lower 500 level prerequisites. Upper 500 level courses were mainly capstones for specific specializations, with mid 500 level or 400 level prerequisites. These 4 categories roughly tracked the career of a grad student, from first semester to capstone, which provided a good set of categories for pattern analysis.[2]

Findings

In examining the data pervasiveness ratings of individual classes, a number of patterns emerged in student data use requirements. As seen in Fig. 2 above, there is wide variation between individual courses, with courses rated at 0, 1, 2, 3 and 4 across all of the curriculum, showing significant variety in Student Data Use requirements across the curriculum. However, looking at the whole curriculum misses some of the

patterns of characteristics that emerged both between classes at specific data pervasiveness ratings and between classes at specific course levels.

When looking at the different courses based on data pervasiveness rating, several characteristics stand out for each level.

Courses at 0

Courses at 0 had no reference to student data use within the syllabus, either explicit or implicit. These courses were often explicitly framed as theory or history of the discipline courses, where assignments were about historical analysis or theory based literature review. These were mainly clustered in the middle of the curriculum, with 68% falling just in the mid-500 level classes.

Courses at 1

Courses at a rating of one almost entirely included their student data use in the final project. These courses cluster toward the top of the curriculum with 61% falling in the upper 500 level class range.

Courses at 2

Courses rated at 2 were spread through the curriculum and did not display any overarching patterns, though those in the upper curriculum tended to lack smaller assignments and focused on large final projects combined with uncategorized mentions elsewhere in the syllabus.

Courses at 3/4

Courses rated at the higher levels of data pervasiveness had data in all aspects of their course structure. These were primarily in the lower level of the graduate only classes, with just over half in the lower 500 level category.

Overall, the trends among the courses showed some interesting patterns for descriptive analysis, specifically, the clustering of upper level courses in level 1 with a focus on final project work compared to the clustering of levels 3 and 4 in the lower 500 level curriculum.

Organizing the data around course level, several other patterns emerged connected to the order in which courses were designed to be taken (Fig. 3).

Lower 500 level

The lower 500 level classes clustered at the top of the student data

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[2] Course types retrieved from https://cuppa.uic.edu/academics/upp/upp-programs/mupp/

Course Level	400 level	Lower 500 level	Mid 500 level	Upper 500 level	Totals by level
Data Pervasiveness 0	1	2	11	2	16
Data Pervasiveness 1	1	3	1	8	13
Data Pervasiveness 2	5	3	5	2	15
Data Pervasiveness 3	0	2	2	1	5
Data Pervasiveness 4	3	7	2	0	12

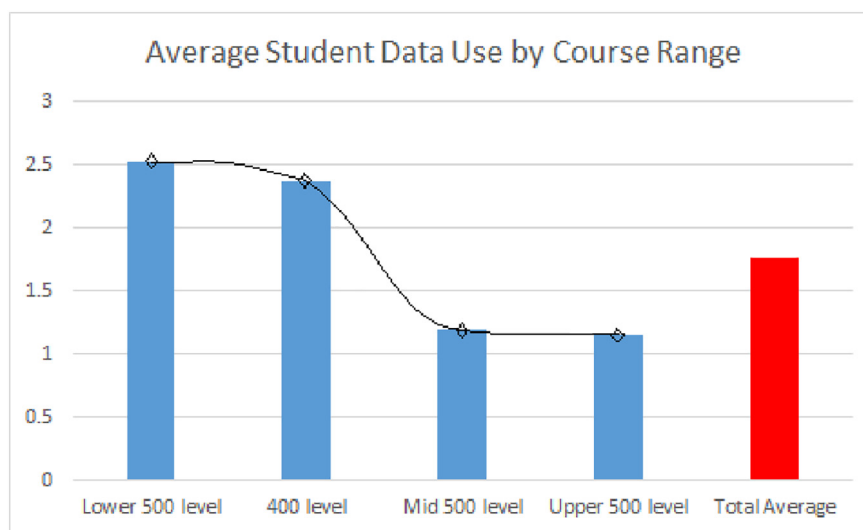**Fig. 3.** A breakdown by level of courses by rating.

Fig. 4. Average data pervasiveness by course.

use level, with more classes rated at 3/4 than all other levels combined and more classes. With an overall average of 2.53, these had the highest data pervasiveness rating.

400 level

The 400 level classes clustered in two main places, at 2 and at 4, for the 2 s, this generally involved a final project with data use and a learning objective. Altogether, these feature an average data pervasiveness rating of 2.36.

Mid 500 level

The mid 500 level classes clustered at the bottom in terms of data pervasiveness rating, including numerous theory classes rated at 0, with a few specialized data classes rated higher. This cluster brought down the overall average of the range to 1.19.

Upper 500 level

The upper 500 level courses primarily clustered around data pervasiveness rating 1, almost entirely consisting of classes with final projects with no other mention of student data use. The overall average of 1.15 reflects this focus.

Based on these observations, it is possible to say the following about student data use in classes within the Urban Planning curriculum.

1. Required intro level courses in the lower 500 level have the highest average data pervasiveness ratings.
2. Student data use requirements do not disappear from the curriculum at the upper 500 level, but student data use is only mentioned in final projects, with few course objectives or general mentions.
3. The mid graduate career courses(400, mid 500) with data requirements have fewer than the lower 500 level but more than the upper 500 level.

Overall, these conclusions point to an Arc of Learning for student data use in the curriculum as seen in Fig. 4, peaking in the lower 500 level courses before descending through the 400 level and Mid and Upper 500 levels. In the early semesters dominated by the courses with high data pervasiveness, students learn the basic tools of finding and using publicly available data resources. Those lessons are reinforced by their follow-up classes, and by the time they are taking advanced courses, students are expected to have mastered these techniques for their own independent projects.

Discussion

When it comes to student data needs, librarians can be useful resources in terms of helping students learn to find and access available data sources such as city open data portals, subject data repositories

such as the Inter-university Consortium for Political and Social Research, or government data resources such as the Census. But that help needs to connect to student needs.

Within this program, student needs for finding and using research data, a key information literacy task, are introduced in a structured fashion from the beginning of the program to the end. Introductory courses teach students how to find and use data in multiple forms, while advanced courses expect students to use data independently. This shows a clear trajectory for student education, what could be called an 'Arc of Learning', with beginner students seen as needing explicit information literacy education to set up later independent success.

Understanding this process allows better targeting of library instruction. Subject librarians have limited time, so it is important to find the classes where information literacy instruction matches student demands. This is where the other half of the examination comes in. By examining syllabi individually, instructional sessions can be tailored for patterns for each course ahead of time, matching the needs of the students and the educational goals of the professors.

Understanding the plan of instruction shows which courses benefit more from library instruction sessions on data sources. For instance targeting 501 and 502 which are rated at 3 or 4 in data pervasiveness and are required early in a student's educational arc, is more productive than targeting 594, which comes at the end of the course of study. In terms of the raw amount of data a given student uses, the final project of 594 almost certainly exceeds all the projects of 501 or 502, but by intervening in 501 and 502, the level of data literacy increases for all courses down the line, including 594, and connects early career students with library resources down the line.

This is similar to educational scaffolding, using early requirements to build capacity for later data use. Without sustained need for direct support, the student is prepared for later needs so as they near completion of the degree they have a level of data literacy commensurate with their expected professional capabilities. This is reinforced in the curricular requirements as many of the courses with the most intense data needs are required courses that must be taken in the first year. Overall, by following the Arc of Learning observed in the curriculum, the subject librarian can use their time more effectively and better prepare students for their needs.

Furthermore, by making explicit reference to syllabus content and the place in the overall curriculum, the librarian can better communicate to reluctant faculty members what the educational goals for a library session are and how they fit within the goals of the class and of the program. This can help prove the utilitarian nature of the library session rather than putting the burden on the faculty member to imagine potential benefits. Coming to a faculty member with a proposal that indicates "I've noticed that students in UPP 502 have to do a number of projects related to finding and using urban planning data, I'd like to do a library instruction session where I show them a number of available repositories for that data. This will help these first semester students be better prepared for their later classes as well" is more likely to be perceived as an active proposal than an open ended "do you need a library session for any of your classes."

Beyond even individual faculty requests, making explicit reference to student information literacy needs and their position in the overall curriculum can serve as an opening for negotiation for a place in the curriculum itself. If all courses of a given type would benefit from a library instruction session, open a discussion with the director of graduate study in the department. This kind of analysis and understanding can open doors for regular instruction and improve student success, in this case, it proved the basis for a set of meetings to provide library instruction sessions in all sections of UPP502.

Conclusions

While these findings are specific to the UIC Urban Planning Program, a similar process could be applied to many different professional graduate programs. By gathering syllabi, analyzing specialized information literacy needs, and comparing those needs to the required plan of study for an individual program, a researcher can identify similar arcs of learning by discipline and track their change across the curriculum.

While the specialized information literacy needs of various programs differ significantly, the specific needs are less important than the process of analysis. By customizing the approach to the material, a librarian can better identify need and improve outreach. While the needs of students may be as different as conducting systematic reviews of treatment interventions in Social Work, researching drug interaction data in Nursing or finding and interpreting ISO standards in Engineering, library instruction can be an essential part of the process. By observing how these skills are targeted in the curriculum through assignments and learning outcomes, the librarian can understand the demands placed on the students and better tailor their instruction to a program's specific Arc of Learning.

In the end, using syllabi to examine specialized information literacy needs and the way in which they move through the curriculum is about serving the needs of multiple communities. It serves the needs of the students to have tailored information literacy instruction based on their career trajectory. It serves the needs of the faculty to have better prepared students in upper level courses to avoid redundant work. It serves the needs of the librarian to be able to reduce the amount of time spent on sporadic instruction. While this takes time in the short term, it represents its own Arc of Learning, as librarians emerge better prepared for their own future tasks.

Declarations of interest

None

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