
Courses aimed at science majors may have different needs and expectations for their students than courses within the same departments aimed at non-majors. As such, academic librarians may wish to seek out alternate methods of assessing student and faculty expectations in these fields. Syllabus analysis is a tool that has been used at several libraries to classify the information literacy expected in different classes, and to anticipate student needs. This study will evaluate whether or not syllabus analysis can distinguish between the different requirements of major and general education classes in the various physical sciences.

Headings:

Curricula (Courses of Study)

Academic Librarianship

Science & Technology Libraries
THE POTENTIAL UTILITY OF SYLLABUS ANALYSIS IN DistingUISHING THE
INFORMATION LITERACY NEEDS OF REQUIRED AND GENERAL EDUCATION
UNDERGRADUATE PHYSICAL SCIENCE COURSES

by
Robert W. Correll

A Master’s paper submitted to the faculty
of the School of Information and Library Science
of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Master of Science in
Library Science.

Chapel Hill, North Carolina
April 2014

Approved by

_______________________________________
Reagan Moore
# Table of Contents

## Contents

- Table of Contents ........................................................................................................... 1
- Introduction .................................................................................................................. 2
- Review of the Literature ................................................................................................
  - Information Literacy of Undergraduates in the Physical Sciences ............................. 6
  - Science Courses for Non-Majors ............................................................................. 8
- Syllabus Analysis ............................................................................................................. 9
- Methodology ................................................................................................................ 14
  - Syllabi Selection ...................................................................................................... 14
  - Analysis ................................................................................................................... 15
- Results and Discussion .................................................................................................. 18
  - Syllabi ..................................................................................................................... 18
  - Library Resource Use .............................................................................................. 18
  - Qualitative Analysis and Usage of “Library” ............................................................ 20
  - Limitations and Weaknesses .................................................................................... 22
- Conclusion .................................................................................................................... 26
- References ................................................................................................................... 33
- Appendix A .................................................................................................................. 36
- Appendix B .................................................................................................................. 37
- Appendix C .................................................................................................................. 38
Introduction

Physical science departments are a key part of many universities, and thus an important population of potential users of academic libraries. Therefore, librarians at these institutions should constantly be aware of the needs of these patrons, in order to provide better service. As a result, all possible tools should be considered when evaluating not only the information literacy requirements of students in these areas, but also of specific populations within these departments, and the manners in which these different populations may have different needs that librarians must be prepared to address. Thus, academic librarians require a fuller understanding of the specific tools available to best distinguish the differences in library skills requirements between different disciplines, so as to allow for instruction and services most directly targeted at their users.

Like most departments, the physical sciences offer classes which are targeted to students majoring in that specific discipline, and courses aimed at the more general student body. Indeed, in many colleges, the number of students in these general education classes will exceed the number of students in that department taking classes for their major. These classes represent different populations of students, and thus may involve different information needs. Because of potential differences, librarians would benefit from an appreciation of the distinctions between these populations, and how they might relate to different levels of library usage or subject-specific information literacy education requirements.
Classes in the physical sciences often follow a strongly linear progression, with each class building upon the previous classes. While this approach is valuable from a pedagogical perspective, it also places strong requirements on what subjects must be covered in a course, in order to provide the foundation for the next course in sequence. If a core concept is not covered in its expected place within the sequence, future classes that assume an understanding of that concept may be rendered significantly less accessible. Students in these courses will need to develop a familiarity with the specific information tools and methods of the discipline, which will continue to serve them throughout their academic career within that major. Conversely, a general education course, which features students who may never take another course in that department, offers potential freedom for more experimentation in course structure and objectives. While these courses should and do offer valuable educational experiences for their students, the lack of focus on preparing for future courses within the department may allow discipline faculty more leeway in terms of what concepts must be covered. At the same time, students in a general education course will generally have less background in the area, and thus require a broader introduction, rather than the more technical focus of an advanced, major-specific course. Both of these concerns may lead students to have different levels and types of information needs, which can and should be addressed by academic librarians.

At the same time, this potential openness to experimentation may encourage discipline faculty to be more open to the possibility of incorporating in-depth bibliographic instruction into the course curriculum. This opportunity can allow librarians not merely to reach a potentially underserved population, but also to build constructive relationships with instructors, who may become more inclined to collaborate with
academic librarians in other areas, improving bibliographic education and user services in other areas of the physical sciences, where discipline faculty might otherwise be more reluctant to modify their instructional practices. Likewise, students in general education courses may gain an appreciation for the research process within the physical sciences, while also incorporating more generalized information literacy skills that will translate to other areas. These students and faculty may also develop a better understanding of the purpose of the academic library, and its role in supporting the broader research and educational mission of the institution. Both of these possibilities, however, require the academic librarian to have a better appreciation of both the unique needs of students in general education science courses and how best to address those needs, so as to optimize both outreach and instruction.

One possible approach to potentially identifying how these differences might affect library use is to analyze the syllabi of classes, in order to identify possible differences in information needs among students in those classes. Identifying these differences may allow librarians to tailor instructional opportunities to these populations, both directly serving their students and building critical relationships with the faculty in those departments, which may serve to improve collaboration in other areas. At the same time, syllabus analysis has not previously been used to draw these distinctions in the area of the physical sciences, and especially not in efforts to distinguish between the needs of students in major-specific and general education courses. Thus, a feasibility study of this potential application may prove valuable, as well as providing preliminary data to allow for further analysis, and providing a guide for methods in which the use of syllabus analysis might be supplemented or improved in this specific context. This study will thus
seek to address the question: “How effective is syllabus analysis as a tool to distinguish between the information needs of students in various physical science contexts?”
Review of the Literature

This paper has been heavily informed by previous findings. While undergraduate students in the physical sciences have not been as extensively studied as have faculty and graduate students in those areas, researchers have conducted some research on student and faculty information needs in this area. Science courses aimed at non-majors are much less heavily studied, especially from a library science perspective. Academic librarians have used syllabus analysis in a wide variety of contexts, providing models for this research.

Information Literacy of Undergraduates in the Physical Sciences

For the purposes of this paper, “physical sciences” will refer to physics, chemistry, geology and classes specifically labeled as “physical science” (the latter generally being aimed at populations such as future science teachers). Each of these disciplines involves distinctly different needs, tools, and academic cultures, which may require different levels of library use. The ability to identify and distinguish the specific needs of each discipline can allow librarians to better tailor their services to their patrons (Whitmire 2002).

After conducting a cross-disciplinary survey of science and engineering faculty, Leckie and Fullerton (1999) found that these faculty had widely divergent perceptions of the need for information literacy skills among their students. The proportion of faculty in the physical sciences expecting their first and second year students to require
bibliographic instruction ranged from 80% among earth science professors to 28% among physics/astronomy professors, with 54% of chemistry professors describing bibliographic instruction in these years as necessary. For third and fourth-year classes, these numbers were 67% for earth sciences, and physics/astronomy and 87% for chemistry. Despite these results, interviews revealed that faculty were often confused about how students developed their information skills, sometimes apparently expecting students to develop them on their own by osmosis. Even among lower level classes, many faculty (including over half of physics/astronomy faculty) reported expecting students to use library resources, and faculty in general expected library use to be more widespread in the third and fourth years. Most discipline faculty also reported not using library instructional services. In response to these results, Leckie and Fullerton urged science librarians to focus on outreach to discipline faculty.

Likewise, Fosmire (2000) found that within the specific discipline of physics, bibliographic instruction was extremely rare among undergraduates. In particular, only 7% of surveyed undergraduates reported receiving physics-specific library instruction. In the discipline of chemistry, Calderhead (1998) emphasized the importance of understanding the complex nature of chemical search tools, which often involve specialized structural search tools not found in other disciplines.

A study by Whitmire (2002) found that undergraduate students in the “hard” disciplines such as physical sciences were far less likely to report using library resources than students in what were categorized as “soft” disciplines. Whitmire strongly urged academic librarians to use a “Biglan” model of “hard” versus “soft”, “pure” versus “applied” and “life” versus “nonlife” in order to understand the differences between
disciplines, so as to better tailor library resources and efforts in order to best serve the user community.

In contrast to the above, Ochola and Peterson-Lugo (2003) found that geology undergraduates used a wide variety of print and electronic resources, and made extensive use of the library. They also found that upper-level students used more scholarly resources than students in lower-level classes. This study demonstrated that students and faculty in this discipline place significant importance in the need for bibliographic instruction, and also suggested that students could benefit from improved clarity in faculties’ expectations of scholarly resource use.

These studies demonstrate not merely the differences between disciplines, but also the importance of expanded bibliographic instruction and outreach in the physical sciences. As undergraduates in the physical sciences have specialized needs that differ from those in other disciplines, academic librarians should be prepared to provide resources or instructional offerings targeted towards these individual needs. Additional tools to allow librarians to identify opportunities to tailor their offerings to specific courses or populations would aid in this endeavor.

**Science Courses for Non-Majors**

Physical science courses aimed at students from other disciplines provide a valuable opportunity for students to learn about scientific literacy and gain relevant skills. Despite these possibilities, there is a surprising lack of research on this specific population within the library literature. Most research in this area has been conducted by educators in the specific disciplines themselves, who generally do not focus as heavily on information literacy skills.
These courses serve a wide variety of students, who can be expected to have widely varying information needs and skills. For example, a survey by Gilbert et al. (2012) found that introductory geology classes reached a variety of students from numerous departments, who took the course for a variety of different reasons. These different populations led to different levels of interest, with students taking the course for general education requirements often reporting much lower motivation than students taking it either to fulfill a major or minor requirement or out of general interest in the subject matter. The classroom population, contrary to stereotypes, also contained a significant portion of STEM majors, despite the nature of the class as targeted to non-majors.

Introductory classes also offer a chance to introduce students to valuable concepts they might otherwise not encounter. Powell and Leveson (2004) argue that introductory geology classes offer an ideal opportunity to introduce students to quantitative reasoning. Goff, Boesdorfer and Hunter (2012) emphasized the value of chemistry classes for non-majors in communicating the nature of science to students from other disciplines. Likewise, Walczak and Walczak demonstrate (2009) that chemistry classes aimed at non-science majors can shape their students’ attitudes, with surveys revealing statistically significant changes in attitudes towards science among students who completed a general education chemistry course.

**Syllabus Analysis**

Syllabus analysis is a technique with a long history. One of the first uses of this methodology in a library context was by Rambler (1982), who used this approach to compare library usage across disciplines and at different course levels within a college,
and recommended the approach for use by other academic libraries in order to improve overall responsiveness to their respective patrons.

A commonly used set of criteria for syllabus analysis was designed by Lauer, Merz and Craig (1989) as part of their comparison of the sophistication of library use at two academic institutions. This rubric, which was used in modified form by later studies such as Dewald (2003), Lowry (2012) and Williams, Cody and Parnell (2004), determines the sophistication of required library use according to a scale ranging from "no evidence on syllabus of library use required" through "library use required for term papers and other research projects", with "significance" defined based on length and portion of final grade (Lauer et al., 1989).

While some of these studies attempted to merely quantify library use, others explicitly sought to draw comparisons between groups. Rambler’s initial study (1982) drew distinctions both between disciplines and between course levels, finding science courses less likely to use library resources than liberal arts courses, and higher level courses more likely to use library resources than lower level courses. However, this study suffered from extremely small sample sizes for many of the comparisons. Lauer, Merz and Craig (1989) used syllabus analysis to compare library usage at a liberal arts college with usage at a larger institution.

Several studies have found syllabus analysis to be a practical tool for identifying information needs and opportunities for instruction and outreach. Sayles (1985) advocated for using a combination of course descriptions and syllabi to support tasks such as collection development and instruction, including tailoring guides to specific classes and assignments. Smith et al. (2012) used the study of syllabi to identify needs for
outreach and found correlations between types of classes and usage of library resources. In particular, they found that art/architecture and social science courses had higher evidence of library use than business or science-technology courses. Dewald (2003) was able to use her study to better target her outreach to business faculty, and was able to discuss bibliographic instruction in the context of specific courses and assignments. Williams, Cody and Parnell (2004) were successful in using the results of their syllabus analysis to improve collection development, instruction and general library awareness. VanScoy and Oakleaf (2008) used a syllabus analysis of first-year students’ courses to identify which skills to focus on during curriculum-integrated instruction, questioning conventional wisdom in the field.

There has been some research on how syllabi can best be used in order to help students. A syllabus contains a variety of helpful information, and ideally should include support services which may be of use to students in the field (Slattery and Carlson, 2005). A study (Becker and Calhoon, 1999) determined that psychology students in their first year at a university are significantly more likely to focus on the support services section of a syllabus, compared with continuing students. Garavalia, Hummel, Wiley and Huitt conducted surveys of faculty and students which suggested that students place more value on practical information such as assignment descriptions and example papers, compared to faculty expectations (2000). A survey of faculty in history, religion, and foreign language/literature departments suggested that the faculty at that institution spent a median of 11-15 hours on preparing a syllabus, suggesting significant effort (Shirkey, 2011).
Despite this research, a review of syllabi at one institution, determining that the majority of syllabi failed to contain the minimum expected information (Habanek, 2005). Only three of the twenty-five syllabi studied met the predefined criteria. Particularly relevant to library usage, only eleven syllabi not only listed course materials, but also where to find them, while thirteen others only listed the course materials, and one required no additional materials. Likewise, details of schedules, assignments, etc. ranged from in-depth to absent.

On the other hand, Haigh (2013) used a survey of students in business schools to determine how the library was portrayed in business syllabi, and found that not only were libraries rarely mentioned, but students were often unclear as to the actual content of their syllabi. 18.8% of students surveyed reported not knowing whether or not their class syllabus had a statement about acceptable resources for class assignments. Furthermore, majorities of surveyed students reported not having statements about libraries, librarians or the use of either Google or Wikipedia on their course syllabi. Haigh’s examination of a sample of 22 of these business syllabi further found that only 2 of them directly referenced the library.

Specifically in scientific disciplines, Dinkelman (2010) conducted an analysis of biology syllabi, which determined a notable dearth of references to libraries or information literacy skills. Inspired by the feedback from an upper level biology course focused on information literacy, this study revealed that many syllabi did not mention course goals at all, and that even among those that did, the course goals rarely included learning objectives linked to information literacy. Furthermore, while many syllabi listed assignments, only 17% of those explicitly suggested the library as a potential source. The
study suggests that syllabi should be as specific as possible about course goals and tools, suggesting specific resources.

Another concern, raised by Williams, Cody and Parnell (2004), relates to the tendency for many syllabi to be updated just before a new semester begins, which limits the ability of libraries to adapt to the specific needs of that class. Thus, resources specifically tailored for that class may not be available in time for librarians to use them.

These studies demonstrate the potential value of syllabus analysis in a wide variety of settings. This tool has not, however, been widely employed in the physical sciences. The ability to examine syllabi in order to potentially distinguish between different disciplines in this area offers a new and potentially valuable opportunity to exploit this approach.
Methodology

The process of this syllabus analysis can be divided into two parts: the selection of the syllabi for analysis and the actual judging of each syllabus itself.

Syllabi Selection

Syllabi were collected from online repositories from two universities, hereafter referred to as “Institution A” and “Institution B.” Both universities are large, public institutions in the eastern United States, which maintain openly accessible online repositories for at least their physics, chemistry and geology departments, completely covering at least the last two years’ worth of syllabi. If a class listed as “physical sciences” was included under the geology, chemistry or physics departments, then it was included in the analysis, although in a separate category from the remainder of the geology, chemistry or physics courses. For each department, at least two semesters worth of syllabi were collected, and for each semester, all listed syllabi were included for separate analysis. Thus, individual sections would be separately analyzed for each class if they had separate syllabi uploaded, so as to incorporate the different approaches that different instructors might take with the same material. In order to maintain consistency, this last process was followed even if the syllabi appeared to be identical.

Several additional criteria were applied in order to ensure a fair distribution. While this study is concerned specifically with undergraduates, the list of 400-level courses included some classes meant for graduate students, a distinction which was not always clear. Thus, in order to specifically consider undergraduate courses, only classes below
the 300 level (or the general institutional equivalent) were included for analysis. To ensure comparability between disciplines, only lecture classes were included; syllabi specifically for laboratory sections were rejected. If a course included both lecture and laboratory components under a single syllabus, that syllabus was included.

In order to provide a control group of humanities syllabi, a semester of syllabi from the philosophy department of Institution A were also analyzed. Institution B did not make their philosophy readily available, and so its philosophy syllabi were not included in this analysis. Philosophy department syllabi, being from a radically different discipline, would serve as a test in order to verify the ability of syllabus analysis to distinguish a humanities discipline from the physical sciences. If the methodology was unable to identify statistically significant differences between the physical sciences and humanities, then little validity could be expected from attempting to distinguish between narrower subdivisions such as between chemistry or physics courses, much less major-required or general education chemistry classes. Because the philosophy syllabi were not being used for the purpose of distinguishing between major and general education classes, they were assessed as a single group, rather than being subdivided into those categories.

Analysis

Each syllabus was analyzed according to the criteria used by Dewald (2003, pg. 35) to measure the sophistication of library use requirements in syllabi:

"0. No Research or Library Use Required: No evidence on syllabus of research or library use required.

1. Reserve Readings Only: Library use required for reserve reading."
2. Library Use for Outside Readings (Not Reserve): Library use required or expected to complete optional readings from a list supplied by the professor (not reserve materials).

3. Some Research or Library Use for Shorter Assignments: Some research or library use required for shorter class presentations or shorter writing assignments, e.g., ancillary reading assignments that require self-directed, exploratory behavior. (This category implies the use of general library or Internet material, not reserve materials).

4. Significant Research Projects: Research or library use required for term papers and other research projects of some significance. “Significance” is defined as cumulative pages totaling at least ten and/or value to final grade of at least 20 percent.”

These criteria were applied to each syllabus by a judge. In the event that readings were not specifically identified as reserved materials, they were assumed not to be on reserve, as a key purpose of this analysis was to determine how syllabi portray the information needs and tools of students. In addition, the syllabi were searched for the use of any of the following terms: “library”, “librarian” or some form of the official name of the institution’s library. If any of these words were mentioned in a context relevant to library use or broader information literacy, that fact was noted. This research did not attempt to note the specific number of mentions, merely a Boolean value for the absence of presence of any mentions at all. The author expected the specific number of mentions to be too dependent on overall syllabus length to provide accurate statistics. To minimize order effects, the list of syllabi was randomized and the syllabi were analyzed in that order.

Each class was judged to be a major-required or non-major class while its syllabus was being analyzed. The criteria for the comparison first looked at the explicit description of the course given on the syllabus or the department website, in order to see if it explicitly or implicitly identified the target audience. If no determination could be
made from this information, then the department website was analyzed to see if the course was part of a typical plan of study for students in that major, or if it fulfilled the requirements for a major in that field. If either of these two criteria were fulfilled, the course was classified as a major-required class; otherwise, the course was classified as a general education class for the purpose of this analysis.
Results and Discussion

This section describes the selected syllabi and the quantitative and qualitative findings from the analysis process. These findings are supplemented by a brief discussion of the limitations and weaknesses of this study, and of syllabus analysis more broadly. The appendices contain more detailed listings of the results of the various analyses.

Syllabi

A total of 152 syllabi were gathered for analysis. Of these syllabi, 73 came from Institution A, while 79 came from Institution B. This number includes the 31 philosophy syllabi collected from Institution A. In the case of both institutions, the geology departments offered significantly fewer course syllabi than the other departments, with Institution B requiring the syllabus collection to go as far back as 2011 in order to produce enough syllabi for a minimal analysis. The full characteristics of the syllabi by department are given in Appendix A.

Library Resource Use

The dataset was insufficient to detect a statistically significant difference in overall rating between general education and major-required classes. Each comparison was run between major and non-major courses within its own department, so as to avoid the known effects of differences in library use between disciplines. The lack of statistically significant results was principally due to the high level of classes demonstrating no significant use of library resources, rendering most cells in the matrix relatively empty.
When the test was run again to distinguish between courses with a nonzero library use rating and those with no evidence of significant use, the Pearson Product results remained not quite statistically significant at the .15 level, but demonstrated greatly improved cell counts. The full breakdown of syllabi by library use rating is given in Appendix B.

Much more significant than the differences within departments were differences between departments. Whereas 71% of philosophy courses demonstrated some level of library use expectation from their syllabi, only 37% of geology courses, 7% of chemistry courses and 10% of physics courses could say the same. As expected, geology was thus the most explicitly library-dependent course, while chemistry and physics had significantly lower rates of use. These differences were significant at the .001 level for the Pearson coefficient. For comparison, Dewald’s study of business courses in the 2001-2002 school year found that 51.1% of business courses at the institution being studied required some level of library use (2003).

One potentially noteworthy result lies in the suggestion of differences in library use among general education courses between disciplines. Although these findings must be treated with caution due to the low cell counts, 19% of physics general education classes required the use of library materials, whereas none of the chemistry general education classes in the study had similar requirements. This finding, which stands in stark contrast to the results in the case of major-required courses, suggests the need for further study, in order to determine whether it represents an accurate finding or a statistical fluke brought about by the limited sample sizes at play.

These results demonstrate the inherent differences between different disciplines in terms of resource use. Whereas most philosophy courses explicitly involve library
research, even geology classes expressed much less need for library usage in their syllabi. This agreement with expected results supports the validity of these criteria for identifying library use on a broad scale. At the same time, the relative paucity of library usage as expressed on syllabi highlights potential areas for expanded collaboration on the part of librarians, as well as suggesting the need to look for unconventional methods of developing information literacy skills among physical science students.

**Qualitative Analysis and Usage of “Library”**

Syllabi varied greatly in format, ranging from brief 2 page descriptions to detailed compilations numbering over 20 pages in length. Syllabi characteristics seemed to depend mostly on the preferences of the individual instructor rather than the course or department. Many instructors seemed to largely reuse their previous syllabi, with only minor modifications. Some syllabi included detailed descriptions of assignments and class schedules, while others merely gave brief overviews of basic course policies. Many, but not all, syllabi included a discussion of course goals, either in the form of the official course description from the catalog, or in the instructors’ own words. Additional information varied widely from instructor to instructor, ranging from detailed course schedules with dates for expected textbook readings, to a brief biography of the instructor and his research interests. Many syllabi indicated that additional information was available on the course website, or through course management software, neither of which was accessed for the purposes of this analysis.

Mentions of “library”, “librarian” or the individual institution’s library were extremely scarce. Of the 152 syllabi analyzed, only 19 mentioned any of those keywords. A full breakdown of those mentions by department is given in Appendix C. In some
cases, the syllabus would even suggest possible sources for acquiring course texts at a discount without mentioning that the campus library had them in its collection, a fact confirmable by a quick search of the library catalog. Syllabi also often included links to specific free resources or tutorials available online for individual study, once again generally without listing resources available through the library. In at least one case, the syllabus specifically advocated using “the internet” as possible research tool, without mentioning the library website or the library’s resources, and without providing further guidance into acceptable research methods. Another professor indicated that additional readings would be provided as “email attachments,” with no mention for the source of these attachments, or even how they were obtained. Syllabi did not generally specifically mention the library as a resource, or specify the type of sources needed for projects.

Syllabi did not include any explicit mention of library instruction sessions, but this particular finding should be treated with care, as most syllabi did not include a detailed course schedule of any sort.

These differences between syllabi highlight the need for standardization of syllabus requirements even within disciplines. Not only the level of detail but the general information included varied drastically between syllabi, even between different sections of the same course. These differences not only hinder syllabus analysis, but more importantly may interfere with the ability of students in these courses to quickly and efficiently obtain the information they need. By standardizing format and information covered, instructors can improve the usability of their syllabi for their students, who are the ultimate users of these materials.
All of these analyses suggest that librarians must strive to better market themselves, in order to ensure that students and faculty in the physical sciences are fully aware of the opportunities available through the academic library. If instructors are familiar with the capabilities provided by their institution’s library system, they may be more likely to include references to those capabilities, which will inform their students. On the other hand, if syllabi and professors are not mentioning library resources, then academic librarians must find other ways of communicating their offerings to students. The dearth of mentions of library related terms are symptomatic of the broader lack of emphasis on information needs in these syllabi, despite the findings of studies such as Leckie and Fullerton (1999) that highlighted the perceived importance of library skills in the sciences.

**Limitations and Weaknesses**

There are several limitations inherent in syllabus analysis that may impact this study, and affect the validity of syllabus analysis as a tool. In addition to the paucity of data due to the limited number of available syllabi, analyses such as this one must also face the possible unreliability of syllabi, both due to limited information content and due to the difference between the written syllabus and the class in practice. Furthermore, the strong dependence of syllabus design on the individual preferences of the instructor, combined with the often small numbers of courses being offered, leaves open the possibility that results of a study at one or two universities may not be generalizable to other institutions, as different personalities, syllabus requirements and academic cultures may lead to significantly different tendencies in syllabus design.
Due to the limited amount of information available, the syllabi may not express the full library usage of a class. Assignments were often described in vague terms or not at all, with the implied expectation that they would be further discussed in class or through additional handouts. It was thus sometimes unclear to what extent a project involved library research. In these cases, the judge had to use the best available judgment from the information provided. Likewise, a professor might indicate that additional materials would be provided throughout the semester, with no indication of what these materials might include, and whether they might involve the library. Thus, future syllabus analysis could be strengthened by access to this course-specific material, which is not found on the syllabus.

Another concern lies with the difference between what is stated in the syllabus and what actually occurs during class. As syllabi are generally uploaded to the online repositories at the beginning of a semester, they do not reflect any modifications made during the course of that semester. Classes may fail to adhere to initial expectations for any number of reasons, ranging from adverse weather conditions to student feedback. Not only are these changes unavoidable, they may be beneficial to the class as a whole; nevertheless, they render syllabus analysis potentially unreliable. The syllabus may also not reflect course content for other reasons, such as collaborations with other instructors or simple omissions. As many syllabi suggest that further materials or details will be given during class or through course websites or other electronic communications, this later information is unavailable to the syllabus analyst. Furthermore, as Haigh (2012) demonstrates, students may not accurately recall the full details of the syllabi, which
limits the potential value of this tool as a reflection of the information students perceive as available.

While this study did not directly study the link between instructors and syllabi, qualitative observations in the course of the analysis suggest that instructors exhibit strong personal preferences in terms of what material to include or exclude, as well as what formats to use for the syllabus, and how to distribute information between syllabus, course website, and any course management software in use. Instructors frequently recycle formats and even entire sections from their previous syllabi. This tendency is not merely limited to different iterations of the same course, but also takes place between different courses taught by the same instructor. Different instructors may also prefer different modes of assessment, which can directly affect the level of information needs required for certain classes, due to the difference in library usage associated with various types and sizes of assignments.

While these weaknesses provide cause for concern, they also highlight possible extensions to the analysis. Syllabi frequently lacked complete information about assignments or resources that might be available through course websites or class notes. A study with access to these materials might alleviate some of these difficulties, and librarians would be well served to ensure access to them. Especially due to the often limited changes in syllabi in the physical sciences, access to some of these materials might prove valuable for better appreciating the needs of students. Likewise, surveys or interviews, although expensive in terms of both time and resources, might allow for better clarification of the accuracy and reliability of a syllabus as representations of the actual practice and expectations embodied in the class itself. Direct faculty outreach to
professors, in addition to being valuable in and of itself as part of the duties of an academic librarian, would also offer opportunities to refine definitions and better understand the context of any findings derived from syllabus analysis, which in turn could contribute to the most efficient use of library resources in targeting students in both major-required and general education physical science courses.
Conclusion

These results demonstrate both some of the strengths and some of the weaknesses of syllabus analysis as a tool for academic librarians. As expected, the methodology was able to identify differences between the various disciplines in terms of which departments expected higher levels of library use among their students. Furthermore, these results agreed with the a priori expectations, such that philosophy classes included a more significant library component. This information supplements previous work on the differing information needs of undergraduate students, while also illustrating the ability to use syllabus analysis to examine new fields.

Further work in this area should supplement this research with the use of other resources. In particular, faculty and student surveys could provide a different view of the subject, as well as highlighting how students perceive their information needs, rather than merely relying on information included within the syllabus, which is generally a product of the instructor. In addition, attempts to design and implement information literacy instructional tools specifically tailored to students in general education science courses would provide practical data, which could then be used to refine the research process, and better identify important markers of information needs among students in these fields, fueling a virtuous circle of improvement.

Particular areas where surveys or interviews might be especially beneficial include how students and faculty perceive the difference in goals, motivations and objectives between general education and major-specific classes, and to what extent that
varies between departments. As a well-designed survey or interview allows for potentially more standardized and controlled information gathering than the analysis of a syllabus, this information can be made more directly comparable. Further study in this regard could inform bibliographic instruction design, as different objectives imply different information needs, which in turn imply opportunities for customization of course content.

Future syllabus analyses in this area would potentially benefit from the inclusion of criteria specifically designed to measure the target audience of a course more closely. In several cases, the line between major and general education courses was blurred, especially in introductory classes which might be required for future majors, but also serve a wider audience of potential majors, other interested students, or students needing to fulfill a prerequisite for a different class. These criteria could include direct feedback from students or faculty, enrollment information, or official internal classifications. Not only would this information be useful for improving syllabus analysis, but it could also improve the understanding of instructors and students’ perceptions of the typology of classes, and whether they have different understandings of the boundaries between major-specific and general education courses, which in turn might allow academic librarians to better express these differences in outreach to and discussions with discipline faculty.

Future studies might also benefit from refining the measurement of assignments. Many syllabi describe assignments in only the vaguest of terms. While students may benefit from instructors’ explanations during class or office hours, librarians conducting syllabus analyses may not have these resources as readily available. A strong relationship with discipline faculty could ameliorate these partially. Alternatively, this area lends
itself readily to surveys and interviews, as well as the examination of completed projects from previous years, which might also be susceptible to bibliometric analyses.

The inability to identify statistically significant differences in library usage between general education and major-specific classes may be partially attributable to the relatively limited datasets. The relatively small number of syllabi in each subcategory greatly limited the potential for accurate statistics in such small subsets. Each institution, even large ones such as those considered in this study, only teaches a limited number of classes each semester, and thus only offers a comparatively small number of syllabi, especially in smaller departments. A larger study, with access to more data, would allow a more detailed investigation of the differences between disciplines and their subgroups, especially if combined with other research tools, such as surveys or interviews with faculty and students. Future work in this area could be extremely beneficial, opening up options for tailored instructional courses and providing valuable data on the possible significance of the distinction between these courses.

Regardless of the statistical difficulties, this analysis demonstrates the distinct lack of mention of library resources among syllabi aimed at undergraduates in the physical sciences. Students may not be aware of the information resources that the library provides, or may be uncomfortable using them; explicit endorsement by the official course syllabus could help alleviate this problem. Librarians might benefit from explicitly encouraging instructors to mention library resources in their syllabi, both in order to inform students and to build personal relationships with discipline faculty. This approach would also have the benefit of reinforcing the instructors’ appreciation for the resources available through the library system; especially in light of the noted tendency of syllabi to
address information needs without explicitly mentioning the potential role of the library in meeting those concerns.

This study also strongly suggests the specific importance of outreach by librarians to discipline faculty in the natural sciences. The lack of mention of specific library resources even in syllabus contexts where they are directly relevant may imply either a lack of emphasis or a lack of awareness on the part of the instructor; either option might be best remedied by outreach. Further study, possibly including personal interviews, would allow for a better understanding of how faculty perceive the syllabi as being used by their students, and the role of libraries and librarians in imparting information literacy skills to their students.

Another key conclusion from this research is the relative lack of uniformity in syllabi. There was little if any evidence of standardization in the syllabi examined, despite the existence of significant research on what students need from syllabi. The wide disparity in syllabus lengths was mirrored by the significant differences in information covered within the syllabus. This situation might be addressed by encouraging academic institutions to create a standardized format for syllabi, with requirements that instructors include certain items within their syllabus and some level of standardization in terms of layout. These standards should be informed by further research, with a specific focus not only on the information needs of students using syllabi, but also on possible differences in syllabus use among students at different levels and in different disciplines. Syllabi that are relatively uniform among classes may allow students not only to more rapidly find the specific pieces of information for which they are looking at any given time, but also to better appreciate the overall coverage and expectations of the class as a whole.
Conversely, the current heterogeneity of syllabi may undermine their broader utility to students.

Academic librarians specifically should seek to address this lack of uniformity by encouraging the creation of readily accessible syllabus repositories, and the implementation of standards for syllabi associated with those repositories. Not only would this allow librarians to more readily exploit syllabus analysis as a tool, but it would also improve the utility of syllabi for students, the intended end-users. To this end, librarians should encourage faculty to familiarize themselves with best practices in syllabus design, perhaps creating guides for this purpose. While ultimate responsibility for designing each syllabus must ultimately lie with the instructor who will be teaching that class, librarians can offer their own assistance in identifying and implementing best practices.

Possible examples of tools that librarians can offer to support discipline faculty in the process of syllabus design include creating guides or checklists, offering assistance to patrons with this issue as with any other research need, and providing examples of “good” syllabi to act as models for faculty. If the broader academic institution implements specific guidelines for syllabi, librarians can work to publicize and explain these criteria. Otherwise, the library can provide more general resources for faculty interested in syllabus design, whether in the form of online guides, or collecting more traditional print materials in this area. Prior syllabi should be collected where possible, with librarians potentially highlighting certain syllabi that most exhibit the best practices for design, so as to provide examples for faculty who wish to create new syllabi or revise existing ones. While academic librarians should not open themselves to the perception of
usurping the control that instructors have over their course design, librarians can offer assistance in this area as with any other information need.

A final concern raised by this study is the important role of supplementary materials such as course websites and other electronic notices to augment the traditional syllabus. Many syllabi assumed student access to this material, which was not assessed for the purposes of this study. While some syllabi provided reasonably detailed descriptions of the sorts of materials that students would be expected to access through course management software or other tools, many instructors left this question largely unaddressed. This missing information could potentially seriously affect the apparent information needs of students, as assignments, readings and other important assessment criteria may be found exclusively through these means.

A possible area for future exploration would be maintaining readily accessible copies of these supplementary materials, which might provide useful information not only to librarians interested in analyzing class offerings at these classes, but also to new instructors, current or prospective students, and other concerned bodies. The frequency of mention of such materials indicates that they are becoming increasingly important as complements to the traditional syllabus; librarians might thus be interested in ensuring some level of access for similar reasons as they might encourage the accessibility of syllabi more broadly. As publicly accessible syllabus repositories provide a tool for individuals outside of a given course, the lack of access to this material could potentially pose a concern for the broader mission of the institution. At the same time, course websites and course management software provide potentially useful and convenient tools to aid instruction. This question deserves further research by a more focused study.
Thus, syllabus analysis has uncovered several opportunities for improvement in library instruction, but also suggested areas of concern. The sheer number of syllabi required for statistical analyses to be valid limits the ability to “target” certain disciplines for further analysis. While the methodology may allow broad distinctions to be drawn between subject areas, narrower distinctions are harder to address. The tendency for these syllabi to have incomplete information also limits the broader utility, and suggests librarians should supplement such studies with analysis of class notes to receive a better picture of actual class practices and needs.
References


Appendix A

This appendix contains the distribution of syllabi collected between the different departments, institutions and subdivisions. For discussion of how these syllabi were collected, see the “Methodology” chapter. For analysis of these data, consult the “Results and Discussion” chapter.

<table>
<thead>
<tr>
<th></th>
<th>Summary of Syllabi for Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Institution A</td>
</tr>
<tr>
<td>Physics</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>17</td>
</tr>
<tr>
<td>general education</td>
<td>4</td>
</tr>
<tr>
<td>major-required</td>
<td>13</td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>15</td>
</tr>
<tr>
<td>general education</td>
<td>3</td>
</tr>
<tr>
<td>major-required</td>
<td>12</td>
</tr>
<tr>
<td>Geology</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>9</td>
</tr>
<tr>
<td>general education</td>
<td>6</td>
</tr>
<tr>
<td>major-required</td>
<td>3</td>
</tr>
<tr>
<td>Physical Science</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>1</td>
</tr>
<tr>
<td>general education</td>
<td>1</td>
</tr>
<tr>
<td>major-required</td>
<td>0</td>
</tr>
<tr>
<td>Philosophy</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>31</td>
</tr>
<tr>
<td>general education</td>
<td>NA</td>
</tr>
<tr>
<td>major-required</td>
<td>NA</td>
</tr>
</tbody>
</table>
Appendix B

This appendix contains listings of the syllabi, divided by type and library use rating. For a discussion of how these data were generated, including a detailed definition of the library use rating, see the “Methodology” chapter. For analysis of these results, see the “Results and Discussion” chapter.

<table>
<thead>
<tr>
<th>Department</th>
<th>Rating</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Physics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>24</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>general education</td>
<td>13</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>major-required</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>53</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>general education</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>major-required</td>
<td>33</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Geology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>general education</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>major-required</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Philosophy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>9</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>14</td>
</tr>
</tbody>
</table>
Appendix C

This appendix categorizes the syllabi according to the presence or absence of mentions of “library”, “librarian” or a form of the official name of one of the institution’s academic libraries. For a description of how this list was compiled, see the “Methodology” chapter. For more in-depth discussion of the results and their meaning, see the “Results and Discussion” chapter.

<table>
<thead>
<tr>
<th>Department</th>
<th>Mentioned?</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>8</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>general education</td>
<td>3</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>major-required</td>
<td>5</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td><strong>Chemistry</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>4</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>general education</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>major-required</td>
<td>4</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td><strong>Geology</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>2</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>general education</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>major-required</td>
<td>1</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td><strong>Physical Sciences</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>0</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>Philosophy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>5</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>