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Paula Barnett-Ellis

*Jacksonville State University, pbarnett@jsu.edu*

Yingqi Tang

*Jacksonville State University, tang@jsu.edu*

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**User-Centered Collection Development:  
A Citation Analysis of Graduate Biology Theses**

By PAULA BARNETT-ELLIS and YINGQI TANG

*Jacksonville State University, Jacksonville, Alabama*

*The authors sought to identify biology collection usage among graduate students at Jacksonville State University. Forty Master's student theses from 2008-2014 were examined. A total of 2,351 citations were analyzed, of which journals accounted for 75%, books for 10%, and the remaining 15% included government documents, web sites, dissertations, and theses. Findings are consistent with previous similar studies that students referenced journals more often than books and other sources. Journal and book citations present discrepancies between number of citations and number of authors citing. Wide ranges of journal subjects were cited due to the interdisciplinary nature of graduate programs. Recommendations are provided for future collection development and library instruction practice.*

KEYWORDS: collection development, citation analysis, biology, graduate students, theses

INTRODUCTION

Gathering and assessing information regarding library collections and their usage is an important fact of life for academic libraries. Subject specialist librarians at Jacksonville State University's Houston Cole Library (HCL) conduct collection assessments roughly every five years, and more

often if needed for reasons such as documentation for re-accreditation of specific programs or building collections for new programs. The HCL's collection assessments are conducted using collection-centered techniques that provide an overview of the library's collections, help justify expenditures, and enhance academic curricula. The assessment method compares holdings against an authoritative list for the purposes of determining collection strength and quality, rather than a collection's quantity (Robinson 1981). Such assessments yield a list of items to be considered for acquisition. However, these methods cannot identify how patrons are using resources in the library. Citation analysis is one method that can be used to examine the type and age of specific materials that are being used.

There have been many articles written about citation analysis, in a variety of academic disciplines, with studies conducted using many different methods, including manual or software analysis. One of this study's differences from a number of others examined is the use of citation analysis along with a subject collection assessment to take a closer look at library resources and their use, as well as quantifying the available resources.

A study was conducted to examine what sources biology master's students used in their theses, whether the Library's biology collection was meeting the needs of researchers, and how the results can be beneficial for future collection development and library instruction.

## BACKGROUND

Jacksonville State University (JSU) is a medium-sized regional university located in Jacksonville, Alabama, with an enrollment of around 9,000 students. The school was established in 1883 and initially served as a state teacher's college. Jacksonville State University now serves both undergraduate and graduate students with over 45 degree programs. JSU's Department of

Biology offers a broad interdisciplinary graduate education in the biological sciences that leads to the Master of Science degree. Biology graduate student enrollment for the fall term of 2013 was 37 (JSU Office of Planning and Research 2013).

Built in 1972, the Houston Cole Library is a thirteen-story building which contains eight subject floors arranged by Library of Congress subject headings, which are managed by subject specialist librarians. Each subject librarian's duties include collection maintenance and development, liaison activities, and instruction. HCL librarians regularly conduct collection analysis to gain insight into the use of their collections. The Library's collection consists of around 828,052 volumes, with the Biology collection comprising approximately 20,000 titles in the Library of Congress ranges QH through QR and SB 107-108. The Biological Sciences collection is rated an overall 3cP, Advanced Study or Instructional Support Level, predominately English (Westbrooks and Barnett-Ellis 2011).

Houston Cole Library's faculty liaison program seeks involvement in collection development and management campus wide. Information from publishers, reviews, and approval slips are disseminated to departmental liaisons to share with interested faculty members. Biology faculty members are active in making requests for library materials for their classes and research focus. Requests are routed to the Health and Sciences Librarian, who reviews them for duplication and determination of whether the item is appropriate for adding to the collection. Approved requests are then returned to Acquisitions for review and processing.

## REVIEW OF LITERATURE

Evans (1979) defined collection development as a process where the strengths and weaknesses of a library's collections are identified in terms of user needs and community resources, with

attempts made to correct weaknesses. Evans stated that while various elements of collection development practice may vary among academic, public, school, or special libraries, less variance was found in their collection development policies. Tucker (2013) noted that collection management involves the selection, acquisition, and evaluation of resources. He stated that as libraries devote millions of dollars to the purchase of resources for their collections, it is important to carefully assess and evaluate those resources. According to Richards and Eakin (1997), some of the functions involved in collection development and management include:

- Assessing user needs
- Collection evaluations
- Policy formulation
- Monitoring and managing budgets
- Collection preservation

Quantitative methods are often used as part of the process, particularly to measure the size, breadth, and growth of collections (LaFleur 2011). Johnson (2014) emphasized the importance of librarians' knowledge of their collection, and that collection analysis is an ongoing process which provides information about the existing collection and a library's collecting goals. Collection assessment methods include bibliography list checking, conspectus worksheets, citation analysis, direct collection checking or use of commercial products such as OCLC's WorldCat Collection Analysis Tool, Bowker's Book Analysis System, Ulrich's Serials Analysis System, and others.

The conspectus worksheet, a collection-based method, is created from guidelines provided by the OCLC/WLN Collection Assessment Service, which provides a framework within which to evaluate a library's current holdings and the level of activity at which the

collection is being developed. On the other hand, citation analysis, a user-based method, is used to look at who is using the materials, how often and what their expectations are.

Citation analysis can be a useful tool for college and university libraries (Gregory 2011). Bibliographies, including those of faculty publications and student dissertations and theses can be checked to determine how many items or what percentage of items cited are available in the library. Tucker (2013) stated in a study of faculty citations from the University of Nevada Las Vegas (UNLV) that citation analysis has been used in various ways in research in library and information science. As in many such studies, Tucker reported that journal usage accounted for the highest number of citations. Information gathered from that research has been useful to both UNLV's Collection Management Department and their librarian liaisons in making future collection development decisions.

A major goal of academic libraries is to assist in research carried out by its faculty and graduate students. Research support is provided through access to scholarly literature, and much scholarly research, particularly in the sciences, is published in journals (Crotteau 1998). Evaluation of academic library journal holdings is important for its researchers, especially as journal prices rise and library budgets stay the same or face cuts in funding. A library collection that includes holdings of the journals its faculty and graduate student users are citing can be used as a measure of research support. Keogh (2012) commented that citation analysis of locally produced theses and dissertations can help libraries find out what resources are being used and these studies can assist in making collection management decisions.

Rising expenditures for library resources when library budgets are decreasing is an issue that many libraries face. Bobal and Wirth (2009) addressed faculty worries that journal cancellations due to financial constraints may leave gaps in coverage of subject areas. Data

drawn from citation analysis may be useful to allay these concerns and can give concerned faculty a summary of what their students have been citing, when faculty do not have time to track or analyze the data themselves. They write that “Sharing results with faculty is a way to demonstrate how the library is working to align the collections with faculty and student research” (Bobal and Wirth 2009, 173).

A search of library literature, conducted at the time of this study, revealed a number of studies on citation analysis in various disciplines. Among these the authors found nine studies on biology graduate theses, and one which focused on advanced undergraduate biology students.

Miller (2011) examined 2,783 citations in 25 Master’s biology theses between 2006 and 2010 to determine the characteristics of the sources being cited. She suggested that in times of fiscal constraint, library collections should serve the majority of researchers’ needs. The Library should also offer alternative options such as interlibrary loans and pay-per-view for infrequently used titles. Miller (2011) also reported that her library’s holdings exceeded 93% of cited journals, which is higher than the study presented in this paper (78%).

Kuruppu and Moore (2008) analyzed 29,894 citations of agriculture and biology doctoral dissertations from 1997 to 2006. The results revealed that journals were the most cited format regardless of the subject field; however, biological science subject fields have more citations than agricultural science. They also found that journals on microbiology were being cited more than other journals.

Kraus (2004) studied 770 citations in 33 undergraduate students’ biology research papers in the period of 2000 to 2002. He found that undergraduates, like other researchers, cited journal literature more than books or other sources. Kraus’ study also uncovered some print journals that

have been used frequently by students, and he suggested replacing print copies with electronic subscriptions for easy access.

Kuruppu and Gruber (2006) wrote that understanding the information needs, use, and methods of seeking information presents a myriad of challenges as scholars often assume many roles, including researcher, educator, supervisor, planner, and administrator. In addition, their research interests and needs evolve over time. Constant changes in technology also affects use of information and searching methods. Academic librarians can play a crucial role by providing the resources to fill these complex needs. However, Kuruppu and Gruber's study revealed that library researchers are not always aware of all of the services and resources available to them. A disturbing aspect of the results was that scholars may choose convenience over the quality of information services.

Crawley-Low (2002) evaluated a graduate-level collection in toxicology to determine if it was strong enough to support changes in curriculum, such as new programs or revisions to existing ones. Use-centered studies such as interlibrary loan data, circulation counts and use of electronic resources were used to help evaluate the collection on short notice. Citation analysis and list checking was used for monographs. The author presented a discussion of three methods to assist other librarians as they undertake collection evaluations.

Crotteau (1998), in an analysis of 140 journal articles written by biology faculty, found 4,913 references to 708 journals, with 4,231 unique citations. In addition, a survey was distributed to 25 faculty who cited volumes not held. The 18 responses, a return rate of 72 percent, showed that reprints, trips to other libraries, and personal copies were the most frequent means of obtaining these. He states that while acquisition of journals in their current format will

remain an important part of research for “years to come,” electronic access will (and has) become more prevalent. Future citation analysis will need to take this into account.

Buckley (1997) took a slightly different approach from many studies in his study of citation analysis, examining monograph use in the journal *Conservation Biology* and compiling a bibliography. He writes that, while monographs were not generally used as frequently as journals by researchers in science, authors in *Conservation Biology* proved to be an exception. His quantitative findings were that 47 books were important in citations between 1987 and 1996. Buckley states these resources should be of interest in collection development in the multiple disciplines encompassed by the subjects, and to conservation biologists.

Nabe and Imre’s study (2008), which examined citations in dissertations in plant biology and zoology, showed that the “conventional wisdom” that science researchers rely on current resources is not always true. Their study will be valuable to other libraries for evaluating the value of electronic journal backfiles and the need to retain print backfiles. These statements were also carried out by the JSU biology citations in theses examined for this paper.

Hurd et. al. (1999), on the other hand, found that current journal articles saw “overwhelming” use in the citations of molecular biologists. Hurd found, in an analysis of 44 research articles from 27 different journals, that 91.3 percent of references were to journal articles published in the last five years, with biology journals making up the largest amount of subject areas cited.

According to Brown (2005), molecular biology graduate students turn to traditional, highly regarded scientific journals to find information, yet they do not fully utilize the library’s available online databases, choosing to use PubMed or the bioinformatics databases they learn about in their laboratories. The author notes that subject specialist librarians must expand their

knowledge to cover these resources in order to ensure these students have access to all the library resources available to them.

### QUESTIONS ADDRESSED BY THIS STUDY

This study was undertaken to help the librarians at the HCL find out which resources are used and how many of those items the library holds or to which it provides access. According to Brazzeal and Fowler (2005), academic librarians will better serve researchers by learning their information needs and how they use the information they gather. By examining biology master's theses, the authors of this study sought to find the answers to the following research questions:

- What percentage of citations are to books and what percentage are to journals in biology master's theses?
- What is the age range of books/journals cited?
- Which books/journals are cited most often?
- Which books/journals are cited by most authors?
- Are cited books/journals available in the Houston Cole Library collection?

### METHODS

Biology theses were retrieved by searching the Library's online Voyager catalog (JaxCat) with a keyword search for "thesis and biology," with location specified as "Alabama Gallery," and date ranges from 2008-2014. Each thesis was assigned a unique ID number and its title page and reference pages were photocopied. All photocopied pages were scanned and converted by OCR (Optical Character Recognition) to make the text selectable, editable, and searchable. Thesis identification number, publication year, citation year, citation title, and citation classification

were recorded in a Microsoft Excel 2010 spreadsheet. Citations which presented problems such as incorrect information, abbreviations, or errors in journal titles, typing errors, and unrecognized OCR characters were manually corrected.

In this study, a journal was defined as a periodical that is published in quarterly, bimonthly, or monthly issues pertaining to original research and commentary on current developments in a specific discipline, sub-discipline, or field of study. Book referred to a monograph written on a single subject that is complete in one physical piece (Reitz 2004). Many previous relevant studies analyzed conference proceedings, government documents, reports, dissertations, theses, and web sites separately (Kimball et al. 2013; Miller 2011; and Brazzeal and Fowler 2005). However, results showed that these types of resources did not account for a large proportion in students' citations. Furthermore, collection assessments done by HCL subject specialists mainly focus on periodical and monograph resources. Therefore, references that were not cited from a periodical or a monograph were categorized as "other". In this study, citations were classified as journal, book, or "other" coded with the numbers 1, 2, and 3, respectively. Ages of citations were calculated by subtracting the year of a particular cited publication from the imprint year of the thesis.

EBSCO's A to Z e-journal finder and the Voyager JaxCat online catalog were used to check library holdings for journals and books. Journal and book titles were coded as electronic, print, electronic and print, and no holdings. To determine whether students were citing journals within their own discipline, journals which were cited ten or more times were selected. Subject headings were collected from OCLC WorldCat by journal title searches. Data was recorded and figures were drawn in Microsoft Excel 2010. Descriptive data analysis for this study was conducted using the statistical software package SPSS 22 for Windows.

## RESULTS

A total of 2,351 citations in the 40 Biology Masters theses were analyzed, of which journals accounted for 75% (N=1,758), books for 10% (N=247), and the remaining 15% (N=346) included government documents, web sites, dissertations, and theses. The authors expected to see heavy student use of journal citations, as the Houston Cole Library offers a wide range of journals via database subscriptions that include *Elsevier Science Direct* and *ProQuest Biology Journals*.

### Journal Citations and Accessibility

The number of journal articles cited in a thesis ranged from three to 318, and the average number of citations was 44. The average age of journal citations was 16 years, while median age was 11 years (See Table 1).

[INSERT TABLE 1 HERE]

The most frequently cited articles were between two to thirteen years old. The oldest citation was 345 years old, and the newest was from the year the student published his/her thesis. Use of resources with such varying time periods also points to the broad interdisciplinary nature of JSU's biology graduate program.

[INSERT FIGURE 1 HERE]

Among a total of 1,758 journal citations, there were 719 unique journal titles, and 440 journals were cited once. Table 2 and Table 3 show top cited journals by number of citations, and by number of authors citing, respectively. The *Journal of Medical Entomology* accounted for 44

citations and was cited by five authors. Fewer than five authors cited the *Journal of Biological Chemistry*, for a total of 32.

[INSERT TABLES 2 AND 3 HERE]

The journal *Applied and Environmental Microbiology* topped the list of journals cited by biology thesis authors, with a total of 14 citations. *Ecology* was second, with 10, and *American Midland Naturalist* had 9 citations. *Applied and Environmental Microbiology* was also second in the list of top cited journals, with 37, behind *Journal of Medical Entomology*, with 44. A number of the most-cited titles were journals on specific subjects, such as *Plant Physiology*, which had 28 citations, and *Journal of Bacteriology*, with 23. *Nature* and *Science*, which feature more general overall science coverage, also made the top 10, with 26 and 23 citations, respectively. The authors had expected current journals in specific subject areas to be more heavily used than those in general science, and also expected journal backfiles and books to see less use.

Table 4 displays the subject headings of journals that have been cited ten or more times. The subject headings were retrieved from WorldCat for individual cited journals. The highest number of subjects included Ecology, Science, Entomology, and Insects as carriers of disease.

[INSERT TABLE 4 HERE]

According to the JSU Department of Biology's website, the graduate program is designed for those students that desire a broad-based curriculum with a diversity of course work. Faculty research interests on the website present a variety of topics, reflected in students' theses, which includes tick-borne disease ecology, developmental toxicology, plant environmental stress, Longleaf pine ecosystems, aquatic toxicology, and medical microbiology (JSU Department of Biology 2015). Thesis subjects ranged from ticks to state park plant analysis to prescribed

burning in forests to analyzing the intestinal microbiota of the slimy salamander. In addition, a number of students go on to publish, in the subject areas of their theses, in journals with their thesis advisor or other professors.

Of a total of 719 unique journal titles identified from the theses, the Library owned 560 titles (78%) in print, electronically or both. Moreover, a check of the top cited journals by number of authors citing indicates that the Library held 27 of the top 29 journals, affirming that “The list of most cited journals gives you information about what journals are important to the users who made the bibliographies” (Kohn 2015, 159). The Health and Sciences Librarian tries to keep up the Biology Department’s resources by contact with the Biology Library Liaison and other faculty members and checking with students who visit the subject floor to make sure they are able to find the information they need for assignments.

#### Book Citations and Accessibility

The number of books cited in a thesis ranged from one to 22, and the average number of citations was 6.5. The average age of book citations was 26 years, while median age was eighteen years (see Table 1). The most frequently cited books were between three and 33 years old. The oldest citation was 222 years old, and the newest was from the year the student published his/her thesis. These results ran counter to the authors’ expectations of student use of newer materials. Few citation analysis studies focusing on biology checked the importance of the accessibility of a library’s book collection on biology subjects. Kohn and Gordon (2014) pointed out that students were more likely to cite materials that the local library owns.

[INSERT FIGURE 2 HERE]

Among a total of 247 book citations, there were 193 unique book titles, and 167 books were cited once. Table 5 and Table 6 show the top cited books by number of citations, and by number of authors citing, respectively. One author cited “*Amphibian declines: the conservation status of United States species*” five times. The top cited book *Fishes of Alabama* was cited seven times by six authors. Three individual authors cited the *Manual of the Vascular Flora of the Carolinas* four times, and *Alabama Wildlife* three times. *Fishes of Alabama* was number one with six citations, while the majority of the top nineteen listed books had two and three citations each. These subjects are reflected in student research on the fish and reptiles of Alabama and the environmental health of creeks and rivers in which they are found, and the thesis topics shown in the library’s collection.

[INSERT TABLES 5 AND 6 HERE]

The age of books cited in the biology theses was somewhat surprising, since many of the science subjects collected by the library depend on currency of resources. Again, these subjects reflect the research interests of students, faculty, and thesis advisors.

Of the 193 unique book titles identified from the theses, the Library owned a print copy of 101 titles (52%), and no electronic books were cited. The preponderance of print resources cited suggested that students rely on hard copy versions. Moreover, a check of the top nineteen cited books by number of authors citing showed that Library held fifteen titles.

## DISCUSSION

Knowledge of the citation pattern and age of citations are valuable for library collection development to help determine whether or not students use the resources. This type of information is not available in collection-centered assessment tools such as those used in the

conspectus sheet and checklists method. A total of 40 biology theses from 2008-2014 provided a snapshot of biology collection usage among master's graduate students. According to the findings, students cited journals more often than books in their research. The median age of journal citations was seven years newer than books. Knowing the age of cited materials will help librarians in making decisions regarding journal subscription cancellations and weeding of book collections.

This study confirms, as do previous studies, the existence of discrepancies between number of citations and number of authors citing journals (Miller 2011; Williams and Fletcher 2006). These findings also echo those of Kohn and Gordon (2014), who found that graduate students were citing more specialized journals as well as major journals like *Nature* and *Cell*. Some possible explanations of this phenomenon are:

- The particular journal that has been cited multiple times by one author contains sufficient articles appropriate for the research topic.
- Students may be more familiar with the particular journal in the subject field.
- The Library's collection is not versatile enough, especially for unpopular subjects in the biology fields.
- Students could not find proper references from other sources.
- Finally, students may not have the skills to find or utilize other means of information gathering available in the library.

Moreover, in comparison with the most cited books by numbers and authors, results revealed that a single author did not cite one book multiple times very often. This might indicate a student

desire to cite a larger variety of sources, although one thesis had less than ten citations, and some had many more.

Subject headings of top cited journals (greater than or equal to ten times) were examined to determine whether students were citing journals within their own discipline. The most cited subjects were Ecology, Science, Entomology, and Insects as carriers of disease. The subject heading of “Insects as carriers of disease” was also substantial, due to the fact that the *Journal of Medical Entomology* was cited 44 times by five students. There were a number of theses on tick-borne disease and other related topics.

No electronic books were cited in the 40 theses examined. As of 2011, the Library had access to 296 e-books on biological sciences, accounting for less than 2% of the book collection (Westbrooks and Barnett-Ellis 2011, 1). At present, the e-book collection may not fully support the students’ research needs. As more e-books are added to the collection, more e-book citations are expected to appear in student theses.

In order to further analyze the differences and the similarities of collection usage among peer institutions, the authors compared the research population, sample size, material distribution, material age, top cited journals subjects, top cited journals, and library holdings with those of prior published biology citation analysis studies (see Table 7).

[INSERT TABLE 7 HERE]

All four studies show much higher rates of citing journals over books and other sources. While JSU biology students seeking reference help also show a preference for journal articles when compared with other institutions, graduate students in the HCL study showed relatively lower journal and “other” usage, such as government documents and websites. Results of other

studies displayed a similar citing pattern: journals were cited the most, and books came in second; however, the JSU study revealed that other sources were cited more often than books. The student authors are likely influenced by the research interests of their thesis advisors, who often have journals or books in their offices, as illustrated by the personal resources faculty place on reserve in the library.

The average age of journals and books cited in this study were older than those reported by other studies. These results are likely due to a few citations from some very old works dated before 1900. The *Journal of Biological Chemistry*, *Nature*, *Science*, and *Cell* made the top cited journal list in three institutions. As *Nature*, *Science*, and *Cell* are very broad in scope, which demonstrates a diversity of fields in student biology research papers. However, biology students also exhibited a high level of interest in molecular and cellular research. As a result, the *Journal of Biological Chemistry* was cited more frequently than other subject focused journals.

The other three studies did not attempt to determine students' research areas. This study used subject headings of the top cited journals in order to identify students' research interests. Moreover, results show that students' research interests seemed to be influenced by their faculty advisors. This may account for the use of library resources which are readily available due partly to their professors' previous requests for the purchase of books and other materials in the faculty's areas of interest.

Another outcome of this study, beyond collection analysis, is that it allows librarians and faculty to learn which resources students prefer to use in research, as well as pointing out problems in citing these sources. A citation analysis of the Biology graduate theses collected in the Houston Cole Library's Alabama Collection had not been undertaken in the more than 15

years that the Health and Science Librarian has been employed. The close examination of citations necessary for this study was a revelation to the authors in terms of student's methods of citing materials.

### Study Limitations

During the data entry process, the authors encountered difficulties in verifying citations due to incomplete and/or incorrect citations. Similar problems also were encountered by Miller (2012) and Kraus (2004). Faculty cautioned students to avoid unintentional plagiarism and encouraged students to use scholarly sources. However, as long as students give credit for the works they have used, faculty do not closely evaluate students' citation behavior, including citation sources and format. Leeder, Markey, and Yakel (2012) noted, in interviews with course instructors, that the citation section is not always graded as part of a paper, because of time constraints and focus on content rather than on the mechanics of writing. In addition, Kohn and Gordon (2014) wrote that faculty might not be evaluating their students' citations closely. At JSU, there does not seem to be a consensus on citation formats used in students' biology papers.

The primary limitation of this study is that the results only represent a small group of biology graduate students' citation patterns for a particular research activity. Results may not show the whole picture of graduate students' information needs on a daily basis. Moreover, faculty and undergraduate students are loyal users of the library; citation analysis of faculty published research papers and undergraduate students' research papers would add another layer of information regarding users' expectations of the collection. Future research could also investigate how different factors might influence students' resource selections.

## CONCLUSION

This study examined the Houston Cole Library's biology collection from the perspective of its usage by JSU biology graduate students and went beyond its initial purpose of determining how the library could improve its collection. The interpretation of the citation analysis data, along with routine collection assessments with their conspectus data, provides a multi-faceted view of the biology collection. Houston Cole Library must maintain the collection at the current level to continue to meet the needs of students. With adequate funding, the Library should add new titles or collections to support upper level and graduate students' research needs. Collection development of the local biology journal collection should not only be based on the impact factor ranking of a journal but should also stem from the university's curriculum. In developing the biology collection, care should also be taken to preserve the versatility and usefulness of the collection. Collection assessments conducted by subject librarians offer one look at the HCL's collection and whether the library holds appropriate resources for graduate student theses. The insight from the citation analysis offers another level of assessment useful in making decision to order materials cited that libraries do not hold.

Furthermore, since students' topic selection of their theses may be influenced by their faculty advisors, subject librarians should consider collecting more resources to support individual faculty research needs, so that their students would also benefit from the collection. A preliminary plan could be to review the top ten locally cited journals that the library does not carry, gather faculty's insights regarding curriculum development plans of a subject field, and consider subscriptions to other resources if they would have more potential for usage. Also, the collection could be strengthened in the most cited subject areas.

Finally, HCL librarians should make sure that adequate resources are available for students. When more online and hybrid courses are offered, digital journals and books should be the first types of materials considered. Also, HCL should continue using interlibrary loan and the ALabama LIBraries Exchange Service (ALLIES) universal borrowing service to help students obtain material for their research needs. Subject specialist librarians should routinely review interlibrary loan statistics to identify journals and books that are frequently requested.

A direct practical outcome of this study is that subject specialist librarians will order the cited titles not held, and order books in related subject areas used in the theses. They will continue to work closely with faculty in making selection decisions through the Library's liaison program. Another outcome of this study, beyond collection analysis, is that it allows librarians and faculty to learn which resources students prefer to use in research, as well as pointing out problems in citing these sources. The Biology Department administration and faculty members have said they will address students' citation problems. Library instruction and outreach is needed to help graduate students develop advanced research skills and to make sure that students are able to find, evaluate, present, organize, and cite sources in their graduate work.

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