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Information Transfer in Articles about Libraries and Student Success

Abstract

Connecting academic libraries to the higher education environment is crucial for demonstrating the impact of libraries on student success. The purpose of this study is to examine the information transfer between the disciplines of library and information science (LIS) and higher education in order to evaluate the influence of ideas between the two disciplines. The methods of information transfer were analyzed in 39 articles focused on the library's contributions to student success by examining the cited references, the author and collaborator affiliations, and the forward citations. The findings from the cited reference analysis suggest that LIS is borrowing concepts and methods through citations from the discipline of education. Authorship affiliations showed that some non-LIS authors are publishing in the field of LIS and that LIS authors are collaborating with non-LIS authors. Finally, based on the forward citations, other disciplines are rarely citing LIS research about student success. This article's findings highlight the need to consider research and collaborators outside of the LIS field when researching the library's contribution to student success.

Keywords: interdisciplinarity, citation analysis, authorship, student success, higher education

Information Transfer in Articles about Libraries and Student Success

Introduction

Initiatives to investigate the academic library's impact on student success acknowledge the library's place in the higher education environment. A common theme in the Association of College and Research Libraries' (ACRL) programs to demonstrate library value has been maintaining awareness of the trends and changes occurring in the higher education environments in which academic libraries operate (Connaway, Harvey, Kitzie, & Mikitish, 2017; Oakleaf, 2010). Understanding developments in the higher education environment can guide the work of all academic librarians.

Scholarship and initiatives within the library and information science (LIS) field have further connected academic libraries to the field of higher education. The ACRL *Value of Academic Libraries* initiative and published research studies on the library's impact on student success have been associated with accountability initiatives in higher education (Chiteng Kot & Jones, 2015; Crawford, 2015; Mezick, 2015; Murray, Ireland, & Hackathorn, 2016; Oakleaf, 2010; Soria, Fransen, & Nackerud, 2013, 2017a; Stemmer & Mahan, 2015; Teske, DiCarlo, & Cahoy, 2013). The research focus on the student success outcomes of grade point average (GPA), retention, graduation, and persistence has been justified by demonstrating these are the outcomes that higher education institutions care about (Chiteng Kot & Jones, 2015; Cook, 2014; Haddow & Joseph, 2010; Mezick, 2015; Murray et al., 2016; Renaud, Britton, Wang, & Ogihara, 2015; Soria, Fransen, & Nackerud, 2013, 2014). Additionally, there is agreement that academic librarians need to demonstrate their value using language and methods that will resonate with university administrators (Chiteng Kot & Jones, 2015; Mezick, 2015; Murray & Ireland, 2018; Oakleaf, 2010; Thorpe, Lukes, Bever, & He, 2016).

Although the LIS field is still developing a research base examining the library's contribution to student success, the field of higher education already has a body of literature examining student development and factors that influence student success outcomes. Prior examinations of literature have concluded with calls for LIS researchers to share their findings and integrate their work into the larger higher education scholarly landscape (Folk, 2014; Kogut, 2017). ACRL is also encouraging librarians to

present their research to a broader audience by funding travel scholarships for librarians to present at higher education conferences (Association of College and Research Libraries, 2018b). Utilizing existing research on the areas of importance to higher education institutions can help libraries show their relevance to those outside of libraries as well as advance the place of academic libraries within the field of higher education. However, it is unclear how LIS researchers are integrating research from higher education into their studies. The purpose of this study is to examine if and how librarians are incorporating research from the field of higher education into studies examining connections between student success and libraries.

This paper uses the concept of “information transfer” to explore how librarians are incorporating research from higher education in studies examining the academic library’s impact on the student success measures of GPA, retention, graduation, and persistence. Pierce (1999) identified three methods of “information transfer” between distinct disciplines: *borrowing*, *collaboration*, and *boundary crossing*. When borrowing, “researchers borrow theories or methods from other disciplines, importing them into their own disciplinary literatures” (Pierce, 1999, p. 272). When collaborating, “researchers publish work in their own disciplinary literatures coauthored with members of other disciplines” (Pierce, 1999, p. 272). When boundary crossing, “researchers publish work in other disciplines, exporting theories or methods to other disciplinary communities” (Pierce, 1999, p. 272). Pierce’s (1999) definition of boundary crossing focused on the first author’s discipline, but the definition of boundary crossing in this article is expanded to include any authors’ affiliation. Using Pierce’s (1999) descriptions of information transfer as a guide, this study sought to answer four research questions:

1. What works outside of the LIS discipline are researchers citing in studies of the library’s impact on GPA, retention, graduation, and persistence?
2. Are LIS researchers studying the library’s contributions to student success collaborating with researchers in other disciplines?
3. Are any of the published studies on library contributions to student success boundary crossing?
4. Are other disciplines citing the articles on the library’s contributions to student success?

Literature Review

Interdisciplinarity

Interdisciplinarity is a broad term that describes activities that utilize the works of multiple disciplines (Chang & Huang, 2012). When examining the amount of interdisciplinarity in a field, publications are the unit of analysis because publications represent the knowledge of a discipline (Pierce, 1999). The three methods of information transfer (*borrowing*, *collaboration*, and *boundary crossing*) provide a way to analyze the publications of a field for the influences of other disciplines. The use of citation analysis to measure borrowing between disciplines assumes that the use of information from another discipline illustrates that information transfer is occurring between the two disciplines (Pierce, 1999).

Multiple studies have explored the relationship between LIS and other disciplines using citation analysis (Borgman & Rice, 1992; Chang & Huang, 2012; Huang & Chang, 2011; Julien, 1996; Julien & Duggan, 2000; Julien, Pecoskie, & Reed, 2011; Odell & Gabbard, 2008). One method of determining interdisciplinarity has been to calculate the percentage of non-LIS citations used in each article or a set of articles (Julien, 1996; Julien et al., 2011). To examine the interdisciplinarity in LIS over an almost 30-year period, Chang and Huang (2012) analyzed direct citations, co-authorship, and bibliographic coupling, which occurs when two articles use the same reference.

Within LIS publications, there has been a trend of increasing interdisciplinarity as revealed through analysis of citations in LIS publications to non-LIS publications (Chang & Huang, 2012; Julien et al., 2011). Chang and Huang's (2012) examination of the LIS discipline found that LIS researchers use publications in "general sciences, computer science, business/management, education, and sociology" (p. 31), but the majority of the citations in LIS research were to works from the LIS discipline. For the subset of information behavior literature, social sciences literature is the most frequently cited subject area outside of LIS, and education was the top subject area within social sciences (Julien & Duggan, 2000). The increase in interdisciplinarity is one indication that the field is advancing (Julien & Duggan, 2000; Julien et al., 2011). Yet, the degree of interdisciplinarity from LIS's influence on other fields can depend

on the LIS sub-field. Odell and Gabbard (2008) concluded that any increase in the influence of LIS research is due to information science and technology research, not librarianship research. Therefore, the question remains if interdisciplinarity in the student success literature is occurring and advancing the research area.

Another area of interdisciplinary transfer is the use of theory from other disciplines. In an examination of research articles published in *The Journal of Academic Librarianship*, Luo and McKinney (2015) found only a few articles that used theories. When articles did use theories, “most of the theories and models originated from fields outside of LIS, such as education, psychology, and business” (Luo & McKinney, 2015, p. 126). Luo and McKinney (2015) demonstrated that researchers are utilizing theories from outside of the LIS discipline, yet it is unclear to what extent researchers are utilizing higher education theories.

Authorship

In addition to citations, co-authorship also indicates a level of interdisciplinarity. “Citing literature and engaging in co-authoring are different aspects of interdisciplinarity,” as each activity requires different levels of commitment from each author (Chang & Huang, 2012, p. 31). The number of co-authorship relationships between LIS researchers and researchers or faculty from other disciplines is increasing (Chang & Huang, 2012; Norelli & Harper, 2013). Related to co-authorship is collaboration with individuals outside of the library on research projects. The Assessment in Action program focused on library projects that could show the library’s connection to student success, and each team was required to have two team members from outside the library (ACRL, 2018b).

Pierce (1999) defined boundary crossing as authorship in the journals outside of a researcher’s discipline. Examining boundary crossing articles from the fields of sociology and political science, Pierce (1999) found that boundary crossing authors typically came from “neighboring disciplines, disciplines likely to be working on similar research topics” (p. 278). Since LIS and higher education are both interested in student success, boundary crossing could occur between library literature and higher education literature.

LIS and Higher Education

Despite the importance of understanding the higher education environment, few studies have looked specifically at information transfer between LIS and higher education. Folk (2014) explored how often librarians were authors in higher education or teaching and learning journals. Librarians were more likely to publish in teaching and learning journals, and information literacy was the most popular topic (Folk, 2014). Folk (2014) argues that librarians publishing in higher education and teaching and learning journals can help academic libraries “be viewed as a vital component in the larger higher education profession” (p. 81). Brock Enger (2007) analyzed higher education and LIS as disciplines still working to develop their own methods, theories, and frameworks. However, Brock Enger (2007) analyzed LIS and higher education separately without acknowledgement of cross-fertilization of ideas between the two.

Prior research has looked at interdisciplinarity in LIS literature, authorship collaborations in LIS literature, and connections between LIS and higher education, but no study has explored these topics in relation to literature regarding library contributions to student success. Since increased interdisciplinarity is an indication of an advancing field (Julien & Duggan, 2000; Julien et al., 2011), an examination of the borrowing and co-authorship in the LIS student success literature can show if the research on connections between libraries and student success is becoming more sophisticated. This study will utilize citation analysis and content analysis of authorship job titles and departments in order to examine the degree of borrowing and collaboration between LIS and other disciplines in research articles about library contributions to student success.

Methods

Identifying the Studies

In order to generate a set of articles related to academic libraries and student success, a systematic literature search was conducted across LIS and education databases. First, searches were performed in Library & Information Science Source (EBSCO); Library, Information Science & Technology Abstracts (EBSCO); ERIC (EBSCO); and Scopus. The core search terms were academic libraries and student success measures. The results were limited to 2010 to August 2017, academic journals, and English

language. The date range focused on literature after the publication of *The Value of Academic Libraries* (Oakleaf, 2010), which called for librarians to link assessment with the goals of higher education institutions and outlined a research agenda for demonstrating the library value. The search was limited to academic journals in order to facilitate the citation analysis. Next, *The Journal of Academic Librarianship*, *portal: Libraries and the Academy*, *Evidence-Based Library and Information Practice*, *College & Research Libraries*, and *College and Undergraduate Libraries* were searched individually to identify any pre-prints. These journals were selected based on the numbers of times that they appeared in the database search results and the journals' focus on research related to academic libraries.

Articles included for analysis focused on student success metrics identified as important to higher education administrators. Included studies were published from 2010 to August 2017; conducted in an academic or college library location; utilized the college or university student population; had a primary purpose or a research question investigating an academic library's impact on persistence, GPA, retention, graduation rates, degree attainment, degree completion, or time to graduation; and were in the English language. Thirty-nine articles were included in the analysis.

Extracting the Data

The authors and collaborators, theoretical frameworks, and article's references were extracted from the 39 included articles. The author's job titles were collected based on the information in the published article. Additional collaborators were determined from the acknowledgements or full text of the article. If mentioned, the theoretical framework or model for each study was noted. The article's references were exported from Scopus into EndNote for analysis. Finally, in November 2017, the forward citations to each of the 39 articles were imported into EndNote from Web of Science, Scopus, and Google Scholar.

Data Analysis

The authors, theories, and citations were analyzed separately. The job titles and affiliations of the authors and collaborators were categorized into library practitioner, faculty in LIS degree program, or

non-LIS, which included all other affiliations. The theoretical frameworks were analyzed to determine any trends. The extraction of the citations and the determination of non-LIS occurred simultaneously.

The citation analysis excluded anything published in traditional LIS venues in order to focus on the information transfer into the LIS discipline from other disciplines. The focus for the non-LIS determination was on the original source, not on the article title. A list was created of journals, publishers, websites, presentations, dissertations or theses, and white papers considered LIS. Journals were considered LIS if indexed in the Library, Information Science & Technology Abstracts (LISTA) database or had the “library and information science” subject in Ulrich’s Periodicals Directory. Books were considered LIS if the assigned call number in WorldCat was “Z,” the publisher was an LIS publisher, or one of the assigned subject headings in WorldCat dealt with libraries. Websites were considered LIS if they were from a library, a library organization (e.g., ALA, ACRL), reported a library project, LibGuides, with library in the title, or were from well-known information literacy projects (e.g., Project SAILS and Project Information Literacy). Presentations were considered LIS if they had the word library in the title or were presented at conferences aimed at librarians (e.g., ACRL, Library Assessment Conference). Dissertations and theses were looked up in ProQuest Dissertations & Theses Global database. If the student was in a School of Library and Information Science or the equivalent, the dissertation was considered LIS. The same procedure was used to determine if the forward citations to each of the 39 articles were LIS or non-LIS.

After the non-LIS determination, the 287 references considered non-LIS citations were further analyzed. First, the non-LIS references were divided by type: journal articles, books, and grey literature, which included webpages, reports, conference presentations, data, and personal communications. Seven citations were referring to software and were removed from the analysis. Then, the remaining 280 citations were coded by subject of the source, article topic, author affiliations, and section of article where cited. Each article could be included in more than one section and have more than one topic and source discipline.

Both the journal titles and the article's content were coded by topic. Ulrich's subject headings and Journal Citations Reports' categories were used to classify each of the 77 journal titles into a subject. The 123 journal articles were coded by general topic: "Higher Education," "Methods," or "Other." Then, coded in more detail using content analysis. Next, the authors of the articles were analyzed using either the information provided in the article or a web search.

WorldCat LC class descriptors and subject headings were used to determine the subjects of the 55 book citations. Author affiliations were determined from the author's biography on the publisher's website, the Amazon or Google Books preview, the hardcopy, or as a last resort, Googling the author.

The 102 grey literature citations were first classified by resource type (e.g., conference paper, webpage, etc.). Then, each citation was coded by article topic. Finally, the author affiliations were investigated by attempting to find the original source document. If the original source document was not available or did not contain author information, the authors were not analyzed.

Findings

Characteristics of Borrowed Literature

The LIS literature on student success is citing resources from outside of the LIS discipline, but the majority of references are still to literature in the LIS discipline. Out of the 39 articles, 38 of the articles included at least one reference to a publication outside of the LIS discipline. At the aggregate level, 280 (32%) of the 880 analyzed references were to non-LIS literature. Journal articles were the most frequently cited non-LIS source type followed by grey literature and books. Non-LIS journals comprised 14% of the total citations, grey literature source types comprised 12% of the total citations, and non-LIS books comprised 6% of the total citations.

Four of the 39 articles had half of their references originating from outside of the LIS discipline (Black & Murphy, 2017; Chiteng Kot & Jones, 2015; Emmons & Wilkinson, 2011; Haddow, 2013). These articles span the time-frame of included articles and do not suggest a trend of increasing borrowing from other disciplines. At the article level, the highest percentage of references to literature outside of LIS was 78% (Chiteng Kot & Jones, 2015). Three articles had non-LIS percentages slightly above 50%

(Emmons & Wilkinson, 2011, Black & Murphy, 2017, and Haddow, 2013). Interestingly, Black and Murphy (2017) and Haddow (2013) both cited a higher percentage of grey literature LIS-sources than journal articles. See the Appendix for the reference counts for each included article.

Authors are using the non-LIS literature to frame the problem, situate their work in the scholarly literature, and to design their studies (see Table 1). Out of the non-LIS citations that were in an explicitly labelled section of the paper, the highest number of citations were in the literature review section. Twenty percent (65) of the article citations were in the introduction, background, or problem sections of the article. Twenty-five percent (80) of the citations were cited in the conceptual framework, methods, or analysis section, which suggests that authors are using outside literature to design studies. Less frequently did authors integrate non-LIS literature into the discussion section.

Section	Count	Percentage
Literature Review	96	30%
Conceptual Framework/Methods/Analysis	80	25%
Intro/Background/Problem	65	20%
Discussion/Recommendations	47	15%
Results	16	5%
Conclusion	11	3%
Limitations	7	2%

Table 1. Section of Article where Non-LIS Reference Cited. Each non-LIS citation was counted once per section of the article in which it was cited.

The theories from Astin (1970a, 1970b, 1993) and Tinto (1975, 1993) were the only theories of student development cited in this article set. Only five articles used student development theories as the theoretical framework of their study. Four articles specifically mentioned using Astin's Input-Environment-Output model as the theoretical framework for the study (Chiteng Kot & Jones, 2015; Soria, Fransen, & Nackerud, 2017a, 2017b; Stemmer & Mahan, 2016). One article (Haddow, 2013) used Tinto's model of student integration as the theoretical framework. Articles that did not have a theoretical framework also cited Astin and Tinto. Seven articles (Emmons & Wilkinson, 2011; Eng & Stadler, 2015;

Haddow, 2013; Mezick, 2015; Soria et al., 2013, 2014, Vance, Kirk, & Gardner, 2012) cited Tinto's (1993), *Leaving College*, and one (Mezick, 2015) of the seven cited two of Tinto's (1975, 1996) other works as well. Seven articles (Chiteng Kot & Jones, 2015; Emmons & Wilkinson, 2011; Murray et al., 2016; Soria et al., 2017a, 2017b; Stemmer & Mahan, 2016; Vance et al., 2012) cited one of Astin's works (1970a, 1970b, 1993) about student engagement. Tinto's work was primarily used in the literature review section, while Astin's work was used both in reference to the design of the study as well as in the literature review.

Topics of non-LIS literature. Looking at the topics of the non-LIS literature, the non-LIS literature was most frequently used for research methods (48) and for retention, persistence, or graduation information (47). The other topics addressed using the non-LIS literature were library contributions to student success (28), student engagement (26), and identification of variables of interest (23).

The majority of articles from outside of LIS came from journals in the education discipline. Forty-three (60%) journals had the general Ulrich's subject of "Education," and 21 (28%) of the education journals were specially labelled "Education-Higher Education" (see Table 2.). Of the 45 journals that were included in Journal Citation Reports (JCR), 15 (33%) are categorized under "Education & Educational Research" (see Table 3). After education, "Statistics" was the most frequently occurring subject in Ulrich's with nine journals and in JCR with 10 journals. The non-LIS journal that was most frequently cited was *Research in Higher Education*. *Journal of Higher Education* and *Journal of College Student Retention* were the next most popular journals (see Table 4).

General Ulrich's Subject	Count
Education	43
Statistics	9
Business and Economics	8
Psychology	6
Medical Sciences	5
Mathematics	4
Computers	4

Biology	3
Sociology	3
Criminology and Law Enforcement	2
Social Sciences	2

Table 2. Most Popular General Ulrich's Subjects for Non-LIS journals. Some journals had multiple subjects and each subject was counted.

Journal Citation Report Subject	Count
Education & Educational Research - SSCI	15
Statistics & Probability - SCIE	10
Social Sciences, Mathematical Methods - SSCI	5
Psychology, Educational - SSCI	4
Economics - SSCI	3
Mathematics, Interdisciplinary Applications – SCIE	3
Sociology - SSCI	3
Biology – SCIE	2
Computer Science, Interdisciplinary Applications – SCIE	2
Criminology & Penology - SSCI	2
Management - SSCI	2
Mathematical & Computational Biology – SCIE	2
Nursing – SCIE	2
Nursing - SSCI	2
Psychology, Applied - SSCI	2
Psychology, Mathematical - SSCI	2
Business – SSCI	1
Communication – SSCI	1
Computer Science, Artificial Intelligence – SCIE	1
Computer Science, Theory & Methods, SCIE	1
Industrial Relations & Labor - SSCI	1
Information Science & Library Science - SSCI	1
Linguistics - SSCI	1

Operations Research & Management Science – SCIE	1
Political Science - SSCI	1
Psychology – SCIE	1
Psychology, Experimental - SSCI	1
Psychology, Multidisciplinary - SSCI	1
Psychology, Social - SSCI	1
Social Work - SSCI	1

Table 3. Journal Citation Report's Subjects for 77 Non-LIS Journals. Thirty-two of the 77 journals were not included in JCR. Journals could have multiple subjects and be included in by the Social Science Citation Index (SSCI) and the Science Citation Index Expanded (SCIE).

Journal Name	Times Cited in Article Set
Research in Higher Education	13
Journal of Higher Education	8
Journal of College Student Retention	5
Biometrika	3
Community College Frontiers	3
New Directions for Institutional Research	3
Research and Practice in Assessment	3
Sociology of Education	3
Journal of College Orientation and Transition	2
American Statistician	2
ASHE Higher Education Report	2
College Student Journal	2
Education Policy Analysis Archives	2
Educational and Psychological Measurement	2
Journal of Adolescent and Adult Literacy	2
Journal of Interactive Online Learning	2
Journal of Statistical Software	2
Journal of the American Association of Collegiate Registrars and Admissions Officers	2
Psychometrika	2
Review of Higher Education	2
Statistical Science	2

Table 4. Non-LIS Journals with More Than One Citation.

The majority of the non-LIS books and grey literature were also classified with a higher education subject (see Table 5). Book subject headings, based on the records in WorldCat, primarily focused on higher education topics and statistical methods. The most popular detailed subject headings

were “college dropouts” and “college students.” The grey literature did not have a clear authoritative subject source, so Ulrich’s subject headings were used as a framework for coding the grey literature by topic. “Education – Higher Education” (70) was the most frequently occurring topic in the grey literature.

Subject Headings	Count
Higher Education	33
<i>College Dropouts</i>	10
<i>College Students</i>	9
<i>Assessment and Evaluation</i>	5
<i>Critical Thinking and Academic Achievement</i>	3
<i>Student Affairs</i>	2
<i>Higher Ed Research</i>	2
<i>College Student Orientation</i>	2
Statistical Methods	15
Econometrics	1
Educational Research	2
Educational Psychology	1
Social Action	1
Reading/Literacy	1
Success	1

Table 5. Non-LIS Book Subjects.

Authors of non-LIS literature. Some of the non-LIS articles and grey literature that the 39 articles cited were boundary crossing with a librarian as the first author or a co-author of the work published outside of the LIS discipline. Four of the non-LIS articles were written by librarians (Ackerman, 2007; Breivik, 1977; Grimes & Charters, 2000; VanderPol, Brown, & Iannuzzi, 2008). Three different articles cited Ackerman (2007) and Breivik (1977), and two different articles cited Grimes and Charters (2000). Out of the non-LIS articles cited more than once, three was the most times that any article was cited. Ackerman (2007) and Breivik (1977) were both librarians and their articles focus specifically on library related topics.

The non-LIS grey literature cited in this article set had the most works written by boundary crossing librarians. Thirteen citations, with eight being unique, of the 102 grey literature citations had at least one librarian author. Sources of these grey literature citations were Educause, the Australian Council for Educational Research, the Annual Forum of the Association for Institutional Research, the North East

Regional Learning Analytics Symposium, the National Institute for Learning Outcomes Assessment, the Conference on First-Year Experience, and a dissertation from the University of Central Florida-Orlando department of Educational Studies. Although none of the non-LIS book authors were librarians, the article and grey literature citations show that LIS is using the literature of boundary-crossing librarians.

Four of the non-LIS articles and one of the book chapters cited were about libraries, but were not written by librarians or published in LIS literature (Cetin & Kinay, 2011; Corlett, 1974; Weinberg, 1974; Williams, 1995; Watts, 2005). This illustrates that authors from other fields do have an interest in libraries and that librarian researchers are using literature related to libraries no matter the field where it was published.

Authorship Collaborations

Authors of articles about library contributions to student success are collaborating with researchers outside of the LIS discipline. Twenty-four of the 38 articles had a non-LIS co-author or non-author collaborator, which means 63% of the articles had a non-LIS co-author or collaborator (see Appendix). Three articles were written by LIS faculty, rather than practicing librarians. Of the 20 articles where all of the authors were practicing librarians, nine mentioned additional collaborators in the acknowledgements section or the text of the article. Three of the 39 articles were Assessment in Action projects (ACRL, 2018a), so staff outside of the library were involved in the research project.

The affiliations and disciplines of the co-authors and collaborators show trends toward working with others who can provide access to student data or have experience with advanced research methods. In the articles where the authors are both LIS and non-LIS, the most frequent non-librarian co-author is someone in institutional research (Cherry, Rollins, & Evans, 2013; Chiteng Kot & Jones, 2015; Soria et al., 2013, 2014, 2017a, 2017b; Stemmer & Mahan, 2015, 2016). Two articles had a co-author from education (Catalano & Phillips, 2016; Montenegro et al., 2016). Additional disciplines of co-authors included criminology (Kinsley, Hill, & Maier-Katkin, 2014), psychology (Murray et al., 2016), computer science (Renaud et al., 2015), and mathematics/statistics (Teske et al., 2013). Twelve articles mentioned collaborators not named as authors in the acknowledgements section or the article's text. The most

common types of collaboration were with individuals who had knowledge of statistical analysis (Bowles-Terry, 2012; Renaud et al., 2015; Samson, 2014; Squibb & Mikkelsen, 2016) or worked in offices with access to student data (Squibb & Mikkelsen, 2016; Teske et al., 2013; Thorpe et al., 2016; Wong & Cmor, 2011; Wong & Webb, 2011).

Boundary Crossing Articles

All of the boundary crossing occurring in the article set is from other fields into the field of LIS. Seven of the 39 articles had a first author who was from outside of LIS. Five of the first authors were analysts in an institutional research office (Chiteng Kot & Jones, 2015; Soria et al., 2013, 2014, 2017a, 2017b). Other first author affiliations were associate professor of foreign language teaching (Çetin & Howard, 2016) and assistant professor in the faculty of education (Montenegro et al., 2016). None of the 39 included articles were published in journals outside of LIS, so this set of articles does not show any LIS researchers boundary crossing into other disciplines.

Other Fields Borrowing of LIS Research

The analysis of the forward citations to the 39 articles shows that other fields are rarely citing the work of libraries and student success. Of the 1,813 citations to the 39 articles, 82% (1,492) were LIS, 12% (222) were non-LIS, and 5% (99) were unable to be determined (see Table 6). When looking at the sources of the forward citations, Google Scholar had the highest percentage of non-LIS citations with 16%, despite 10% of the Google Scholar citations referring to foreign language or other materials that could not be analyzed.

	Web of Science	Scopus	Google Scholar	Total
LIS	257 (94%)	477 (92%)	758 (74%)	1,492 (82%)
Non-LIS	15 (6%)	40 (8%)	167 (16%)	222 (12%)
Unable to Determine	0	0	99 (10%)	99 (5%)
Total Exported from Resource	272	517	1,024	1,813

Table 6. LIS/Non-LIS Forward Citations by Source

The three most common formats of 222 non-LIS works citing LIS student success articles were journal articles, dissertations, and conference papers or presentations (see Table 7). The citation counts are not unique article counts, so the same work could have cited one or more of the 39 student success articles. The most common subject for the non-LIS journals and books was education (see Table 8). More specifically, 17 forward citations were from articles in higher education journals, and two were higher education books. Interestingly, “criminology and law enforcement” was the third most common subject for journals. One of the authors of this article, which was published in the *Journal of Criminal Justice Education*, is a librarian.

Format	Counts (% of total)
Journal Article	87 (39%)
Dissertation	67 (30%)
Conference Paper/Presentation	43 (19%)
Book Chapter	11 (5%)
School Paper	9 (4%)
White Paper	3 (1%)
Monographic Series	2 (1%)

Table 7. Non-LIS Cited by References by Format

Subject	Count
Education (Ulrich's)	29
Education – Higher Education (Ulrich's)	17
Criminology and Law Enforcement (Ulrich's)	13
Education & Educational Research - SSCI (JCR)	11
Computers – Computer Networks (Ulrich's)	10
Computers (Ulrich's)	4
Business and Economics - Marketing and Purchasing (Ulrich's)	4
Business - SSCI (JCR)	4
Computers - Information Science and Information Theory (Ulrich's)	4
Linguistics (Ulrich's)	4
Political Science (Ulrich's)	3
Literature (Ulrich's)	2
Psychology (Ulrich's)	2

Psychology, Applied - SSCI (JCR)	2
Architecture (Ulrich's)	2
Business and Economics - Management (Ulrich's)	2
Building and Construction (Ulrich's)	2
Engineering – Electrical Engineering (Ulrich's)	2
Technology: Comprehensive Works (Ulrich's)	2

Table 8. Non-LIS Journal Subjects for Forward References. This table only includes subjects that have more than one count.

Some LIS practitioners are boundary crossing, and when they do, these librarians cite LIS research in their works. A librarian wrote 24 of the 89 article and monographic series citations. Articles with at least one librarian author were published in the *Canadian Journal of Higher Education*, *Jesuit Higher Education: A Journal*, *Open Praxis*, *Journal of Political Science Education*, and *Oman Medical Journal*. Twenty-one of the 67 dissertation citations were written by librarians who obtained doctoral degrees outside of the LIS field. The majority of these librarians completed degrees in education, and higher education administration or educational leadership were the most frequent degrees mentioned. A librarian authored 19 of the 43 conference paper and conference presentation citations. By publishing in venues outside of LIS and citing the LIS student success literature, librarians are furthering the reach of LIS articles on student success.

Discussion and Implications

Borrowing

The primary subject area cited outside of LIS is education. The use of education literature connects with the student success topic. This finding supports Chang and Huang (2012) who found that LIS researchers mostly use literature from LIS, but integrate other disciplines including education. Although librarians are not borrowing large percentages of literature outside of LIS, when they do, librarians are using high quality literature in the higher education field. The most frequently cited higher education journals are considered to be in the highest tiers according to one study of higher education publications (Bray & Major, 2011). *The Journal of Higher Education* and *Research in Higher Education*

were placed in “Tier 1,” and *Journal of College Student Retention* was placed in “Tier 2” (Bray & Major, 2011).

In the few articles where student development theories are cited, Astin (1970a, 1970b, 1993) and Tinto (1975, 1993) are the theories of student retention and integration mentioned. This supports Luo and McKinney’s (2015) finding that only a few articles published in the *Journal of Academic Librarianship* used theories, and when theories were used, the theories were borrowed from education, psychology, and business. Although some LIS authors have made it clear that libraries operate within the larger higher education context and utilize existing research to frame their studies, the majority do not mention any student development theories. In order to demonstrate the applicability of LIS research to higher education and student affairs professionals, LIS researchers should acknowledge the prominent theories used to view the development of the student during college.

Librarian researchers can further integrate their research with the higher education literature. Authors frequently use non-LIS literature to frame the problem, situation, their work in the scholarly literature, and to design their studies. Authors frame the problem within the higher education context, but do not consistently link back to the context when proposing solutions. By linking their research findings back to the higher education context, librarians can provide additional evidence about why libraries are important to student success.

When examining information transfer by analyzing who is citing LIS literature, the source of the article citations matters. Scopus and Web of Science showed citations to scholarly journal articles and conference proceedings. A more diverse array of grey literature was found in the Google Scholar “cited by” citations. Google Scholar had the highest number of citations to each article, but not all of the citations of Google Scholar were legitimate. Some cited by citations were to articles unrelated to the content of the original article or with a publication date prior to the publication of the article it was supposed to be citing. Other researchers studying the use of Google Scholar to determine impact have documented the problems of Google Scholar citations, including duplicate citations, “phantom and false citations,” and incorrect citation information (Meho & Yang, 2007, p. 2111; Jasco, 2006). Despite its

limitations, some researchers have concluded that Google Scholar shows a “more comprehensive and accurate picture” of the relationship between the LIS and other disciplines (Meho & Yang, 2007, p. 2123). Therefore, when analyzing the information transfer of LIS literature using forward citation analysis it is important to include Google Scholar citations in order to understand the full scope of the information transfer.

The forward citations offered more examples of librarians boundary crossing by publishing their work on LIS topics in other disciplines. The number of dissertations written by librarians who obtained doctorates in fields other than LIS shows another avenue of information transfer. The majority of these librarians obtained degrees in the field of education. Librarians are learning the theories and methods associated with a related field and then using them in their work in LIS. Librarians are also presenting on topics related to student success at non-LIS conferences. The authors whose roles could be verified primarily presented at education-related conferences. With ACRL’s new initiative to fund librarian presentations at non-LIS conferences (ACRL, 2018b), it will be interesting to see if the conference disciplines remain tied to education or if librarians will be presenting a more diverse spectrum of conferences.

Collaborating

Librarians are collaborating with non-librarians to research library contributions to student success. This analysis cannot answer why these articles had a non-librarian co-author or collaborator, but the co-author and collaborator affiliations suggest reasons include access to data and assistance with research methods. Prior surveys of librarian authors have shown one of the common reasons that librarians collaborate is related to the co-author’s expertise (Hart, 2000a, 2000b).

One explanation of the prevalence of collaborators for research methods is that librarians are not prepared to conduct the types of studies that are needed to demonstrate the library’s contribution to student success. Librarians often lack the knowledge and confidence in the use of research methods to conduct studies (Koufogiannakis & Crumley, 2006; Kennedy & Brancolini, 2012). When collaborators were analyzed along with the methods used in articles, non-librarians used more advanced statistical

methods (Slutsky & Aytac, 2014). Therefore, non-LIS co-authors could be bringing in research methods from other fields to study the library's contributions to student success.

Boundary Crossing

One explanation for the lack of LIS authors boundary crossing into other disciplines is that in order for LIS authors to boundary cross into higher education, more advanced statistical techniques are required. The most common research approach in LIS is descriptive, and the most common research methods in LIS are surveys and content analysis (Aytac & Slutsky, 2014). In contrast, correlational designs are the most popular research design in higher education literature, and the number of higher education articles using advanced statistics is increasing (Wells et al., 2015). Based on this article's sample, librarians could be collaborating with non-LIS co-authors and collaborators in order to bridge the gap between LIS research methods and higher education research methods. "There is plenty of room for applying more rigorous methods and enhancing the quality of our [librarianship] research literature" (Koufogiannakis & Crumley, 2006, p. 326). This statement is true in regards to information transfer: getting studies on libraries and student success published in higher education journals requires more advanced statistical methods used in some of the recent articles.

Limitations

The format differences for determining the subjects and author affiliations of the article set's references and forward citations is one limitation of the study. Journals and books were methodically analyzed using reputable sources for subject areas, but the subject determinations for grey literature were more subjective. Each journal, book, and grey literature resource had different procedures for inclusion of the author job titles and affiliations. Reporting differences could have resulted in the lack of identification of additional interdisciplinary collaborations and boundary crossing articles.

Other limitations involve the data sources of the forward citations. First, the forward citations show a snapshot in time. Second, the data quality of the cited by references from Google Scholar prevented a full analysis of the cited by data. The Google Scholar cited by citations included errors in the article listings as well as duplicate citations. Additionally, the author could only analyze citations in

English, so the number of references from Google Scholar that were in non-English languages could influence the percentages of articles that are considered LIS and non-LIS.

Future Directions

This study begins to explore information transfer between LIS and higher education. More research using bibliometrics will help develop this research area. This study focused on traditional citation analysis by analyzing the cited references and forward citations in the article set. Examining the altmetrics associated with an article related to libraries and student success could further illustrate the reach of LIS research into other disciplines. This study also only provides a snapshot of information transfer, and future studies could analyze a longitudinal trend of information transfer in student success literature.

The analysis of the article set's references shows that LIS authors are integrating literature from other disciplines in their work, but they are rarely publishing their work in non-LIS journals. Folk (2014) suggests there are multiple factors (research skills, confidence, promotion and tenure) that could influence a librarian's decision to publish in a non-LIS journal and concludes that investigating the reasons behind librarians' decisions to submit to LIS or non-LIS journals is a future research direction. Additionally, investigating why librarians decide to collaborate with non-LIS professionals and how librarians develop a collaborative relationship with non-LIS professionals will illustrate the depth of these co-authorship and collaborative relationships.

The analysis of articles citing this article set showed that LIS practitioners are pursuing doctorates outside of the LIS field and focusing on student success in their dissertations. Another research direction would analyze the impact of librarians who received doctoral degrees in non-LIS disciplines to determine if having a non-LIS doctorate makes a librarian more likely to use non-LIS citations and to boundary cross when publishing their work. Another avenue of inquiry would explore if these librarians bring in perspectives from non-LIS disciplines into the work they have published in LIS journals.

Astin (1970a, 1970b, 1993) and Tinto (1975, 1993) are frequently referenced in higher education research, but another unexplored area is if there are other higher education theories that LIS researchers

should be considering when studying the library's contributions to student success. Future investigations should consider if other student development theories might offer additional insights into the role that libraries play in student success. Other theories of student retention have been proposed that build from perceived weaknesses of Tinto's theories (Morrison & Silverman, 2012). Additionally, other theories that look holistically at college student development, like ecological development models (Renn & Arnold, 2003) could also provide a theoretical grounding, as the ecological models situate the student within the larger system of higher education.

Conclusion

Studies investigating the library's contributions to student success link the work of academic libraries to the overall mission of universities and to research in the field of higher education. Information transfer through borrowing and collaborating is occurring between LIS and other disciplines, particularly education and statistics. Boundary crossing is occurring from non-LIS researchers publishing in LIS journals, rather than LIS researchers publishing in non-LIS disciplines. The forward citations show more evidence of librarians boundary crossing by publishing in non-LIS journals, presenting at non-LIS conferences, and receiving doctorates in non-LIS fields. While information transfer is occurring in the scholarly artifacts related to the library's contributions to success, the information transfer is not widespread. In order to integrate LIS research into the higher education research base, LIS researchers should consider utilizing research literature regarding student success outside of the LIS field.

References

- Ackermann, E. (2007). Program assessment in academic libraries: An introduction for assessment practitioners. *Research & Practice in Assessment*, 2, 18-23.
- Association of College and Research Libraries. (2018a, July 2). Assessment in action: Academic libraries and student success. Retrieved from <http://www.ala.org/acrl/AiA>
- Association of College and Research Libraries. (2018b, July 2). VAL Travel Scholarships. Retrieved from <http://www.ala.org/acrl/awards/researchawards/valtravel>
- Astin, A. W. (1970a). The methodology of research on college impact, part one. *Sociology of Education*, 43(3), 223-254.
- Astin, A. W. (1970b). The methodology of research on college impact, part two. *Sociology of Education*, 43(4), 437-450.
- Astin, A. W. (1993). *What matters in college: Four critical years revisited*. San Francisco: Jossey-Bass.
- Author. This reference was written by the author and is blinded.
- Aytac, S., & Slutsky, B. (2014). Published librarian research, 2008 through 2012: Analyses and perspectives. *Collaborative Librarianship*, 6(4), 6.
- Black, E. L., & Murphy, S. A. (2017). The out loud assignment: Articulating library contributions to first-year student success. *The Journal of Academic Librarianship*. doi:10.1016/j.acalib.2017.06.008
- Borgman, C. L., & Rice, R. E. (1992). The convergence of information science and communication: A bibliometric analysis. *Journal of the American Society for Information Science*, 43(6), 397-411.
- Bowles-Terry, M. (2012). Library instruction and academic success: A mixed-methods assessment of a library instruction program. *Evidence Based Library & Information Practice*, 7(1), 82-95.
- Bray, N. J., & Major, C. H. (2011). Status of journals in the field of higher education. *The Journal of Higher Education*, 82(4), 479-503.
- Breivik, P. S. (1977). Resources: The fourth R. *Community College Frontiers*, 5(2), 46-50.

- Brock Enger, K. (2007). Understanding the development of disciplines and the ways they contribute to knowledge and reflect practice: An analysis of articles published in higher education and library and information science. In *Advances in Library Administration and Organization* (pp. 1-51).
- Catalano, A., & Phillips, S. R. (2016). Information literacy and retention: A case study of the value of the library. *Evidence Based Library & Information Practice*, 11(4), 2-13.
- Çetin, Y., & Howard, V. (2016). An exploration of the relationship between undergraduate students' library book borrowing and academic achievement. *Journal of Librarianship & Information Science*, 48(4), 382-388.
- Çetin, Y., & Kinay, H. (2011). A causal relationship between Turkish EFL students' academic achievement and borrowed library books. *Gaziantep Universitesi Sosyal Bilimler Dergisi*, 10(4), 1347-1361.
- Chang, Y. W., & Huang, M. H. (2012). A study of the evolution of interdisciplinarity in library and information science: Using three bibliometric methods. *Journal of the American Society for Information Science and Technology*, 63(1), 22-33.
- Cherry, E., Rollins, S. H., & Evans, T. (2013). Proving our worth: The impact of electronic resource usage on academic achievement. *College & Undergraduate Libraries*, 20(3), 386-398.
- Chiteng Kot, F., & Jones, J. L. (2015). The impact of library resource utilization on undergraduate students' academic performance: A propensity score matching design. *College & Research Libraries*, 76(5), 566-586.
- Connaway, L. S., Harvey, W., Kitzie, V., & Mikitish, S. (2017). *Academic library impact: Improving practice and essential areas to research*. Chicago: Association of College and Research Libraries.
- Cook, J. M. (2014). A library credit course and student success rates: A longitudinal study. *College & Research Libraries*, 75(3), 272-283.
- Corlett, D. (1974). Library skills, study habits and attitudes, and sex as related to academic achievement. *Educational and Psychological Measurement*, 34(4), 967-969.

- Crawford, G. A. (2015). The academic library and student retention and graduation: An exploratory study. *portal: Libraries & the Academy*, 15(1), 41-57.
- Emmons, M., & Wilkinson, F. C. (2011). The academic library impact on student persistence. *College & Research Libraries*, 72(2), 128-149.
- Eng, S., & Stadler, D. (2015). Linking library to student retention: A statistical analysis. *Evidence Based Library & Information Practice*, 10(3), 50-63.
- Folk, A. L. (2014). Librarians as Authors in Higher Education and Teaching and Learning Journals in the Twenty-First Century: An Exploratory Study. *The Journal of Academic Librarianship*, 40(1), 76-83.
- Grimes, P. W., & Charters, M. F. (2000). Library use and the undergraduate economics student. *College Student Journal*, 34(4), 557-570.
- Haddow, G. (2013). Academic library use and student retention: A quantitative analysis. *Library & Information Science Research*, 35(2), 127-136.
- Haddow, G., & Joseph, J. (2010). Loans, logins, and lasting the course: Academic library use and student retention. *Australian Academic & Research Libraries*, 41(4), 233-244.
- Hart, R. L. (2000a). Co-authorship in the academic library literature: a survey of attitudes and behaviors. *The Journal of Academic Librarianship*, 26(5), 339-345.
- Hart, R. L. (2000b). Collaborative publication by University librarians: An exploratory study. *The Journal of academic librarianship*, 26(2), 94-99.
- Huang, M. H., & Chang, Y. W. (2011). A study of interdisciplinarity in information science: Using direct citation and co-authorship analysis. *Journal of Information Science*, 37(4), 369-378.
- Jacso, P. (2006). Deflated, inflated and phantom citation counts. *Online information review*, 30(3), 297-309.
- Julien, H. (1996). A content analysis of the recent information needs and uses literature. *Library & Information Science Research*, 18(1), 53-65.

- Julien, H., & Duggan, L. J. (2000). A longitudinal analysis of the information needs and uses literature. *Library & Information Science Research*, 22(3), 291-309.
- Julien, H., Pecoskie, J. L., & Reed, K. (2011). Trends in information behavior research, 1999–2008: A content analysis. *Library & Information Science Research*, 33(1), 19-24.
- Kennedy, M. R., & Brancolini, K. R. (2012). Academic librarian research: A survey of attitudes, involvement, and perceived capabilities. *College & Research Libraries*, 73(5), 431-448.
- Kinsley, K., Hill, L. B., & Maier-Katkin, D. (2014). A research and class model for future library instruction in higher education. *New Library World*, 115(9), 482-495.
- Kogut, A. (2017). Academic library services and undergraduate academic success: Trends in research literature. *Proceedings of the 2016 Library Assessment Conference (2017)*, pp. 365-379.
<http://old.libraryassessment.org/bm~doc/59-kogut-2016.pdf>
- Koufogiannakis, D., & Crumley, E. (2006). Research in librarianship: Issues to consider. *Library hi tech*, 24(3), 324-340.
- Luo, L., & McKinney, M. (2015). JAL in the past decade: A comprehensive analysis of academic library research. *The Journal of Academic Librarianship*, 41(2), 123-129.
- Meho, L. I., & Yang, K. (2007). Impact of data sources on citation counts and rankings of LIS faculty: Web of Science versus Scopus and Google Scholar. *Journal of the American Society for Information Science and Technology*, 58(13), 2105-2125.
- Mezick, E. M. (2015). Relationship of library assessment to student retention. *Journal of Academic Librarianship*, 41(1), 31-36.
- Montenegro, M., Clasing, P., Kelly, N., Gonzalez, C., Jara, M., Alarcón, R., . . . Saurina, E. (2016). Library resources and students' learning outcomes: Do all the resources have the same impact on learning? *Journal of Academic Librarianship*, 42(5), 551-556.
- Morrison, L., & Silverman, L. (2012). Retention theories, models, and concepts. In A. Seidman (Ed.) *College student retention: Formula for student success*, (pp. 61-80). Lanham, MD: Rowman & Littlefield.

- Murray, A., & Ireland, A. (2018). Provosts' perceptions of academic library value & preferences for communication: A national study. *College & Research Libraries*, 79(3), 336-365.
- Murray, A., Ireland, A., & Hackathorn, J. (2016). The value of academic libraries: Library services as a predictor of student retention. *College & Research Libraries*, 77(5), 631-642.
- Norelli, B., & Harper, T. L. (2013). Collaborative scholarship in academic library literature: Who, what, and when. *College & Undergraduate Libraries*, 20(2), 173-196.
- Oakleaf, M. (2010). *Value of Academic Libraries: A comprehensive research review and report*. Researched by Megan Oakleaf. Chicago: Association of College and Research Libraries.
- Odell, J., & Gabbard, R. (2008). The interdisciplinary influence of library and information science 1996–2004: A journal-to-journal citation analysis. *College & Research Libraries*, 69(6), 546-565.
- Pierce, S. J. (1999). Boundary crossing in research literatures as a means of interdisciplinary information transfer. *Journal of the American Society for Information Science*, 50(3), 271-279.
- Renaud, J., Britton, S., Wang, D., & Ogihara, M. (2015). Mining library and university data to understand library use patterns. *Electronic Library*, 33(3), 355-372.
- Renn, K. A., & Arnold, K. D. (2003). Reconceptualizing research on college student peer culture. *The Journal of Higher Education*, 74(3), 261-291.
- Samson, S. (2014). Usage of e-resources: Virtual value of demographics. *Journal of Academic Librarianship*, 40(6), 620-625.
- Soria, K. M., Fransen, J., & Nackerud, S. (2013). Library use and undergraduate student outcomes: New evidence for students' retention and academic success. *portal: Libraries & the Academy*, 13(2), 147-164.
- Soria, K. M., Fransen, J., & Nackerud, S. (2014). Stacks, serials, search engines, and students' success: First-year undergraduate students' library use, academic achievement, and retention. *Journal of Academic Librarianship*, 40(1), 84-91.
- Soria, K. M., Fransen, J., & Nackerud, S. (2017a). Beyond books: The extended academic benefits of library use for first-year college students. *College & Research Libraries*, 78(1), 8-22.

- Soria, K. M., Fransen, J., & Nackerud, S. (2017b). The impact of academic library resources on undergraduates' degree completion. *College & Research Libraries*, 78(6), 812-823.
- Squibb, S. D., & Mikkelsen, S. (2016). Assessing the value of course-embedded information literacy on student learning and achievement. *College & Research Libraries*, 77(2), 164-183.
- Stemmer, J. K., & Mahan, D. M. (2015). Assessing the library's influence on freshman and senior level outcomes with user surveys. *Evidence Based Library & Information Practice*, 10(2), 8-20.
- Stemmer, J. K., & Mahan, D. M. (2016). Investigating the relationship of library usage to student outcomes. *College & Research Libraries*, 77(3), 359-375.
- Teske, B., DiCarlo, M., & Cahoy, D. (2013). Libraries and student persistence at southern colleges and universities. *Reference Services Review*, 41(2), 266-279.
- Thorpe, A., Lukes, R., Bever, D. J., & He, Y. (2016). The impact of the academic library on student success: Connecting the dots. *portal: Libraries & the Academy*, 16(2), 373-392.
- Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research*, 45(1), 89-125.
- Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition* (2nd ed.). Chicago: The University of Chicago Press.
- Tinto, V. (1996). Reconstructing the first year of college. *Planning for Higher Education*, 25(1), 1-6.
- Vance, J. M., Kirk, R., & Gardner, J. G. (2012). Measuring the impact of library instruction on freshman success and persistence. *Communications in Information Literacy*, 6(1), 49-58.
- VanderPol, D., Brown, J. M., & Iannuzzi, P. (2008). Reforming the undergraduate experience. *New Directions for Teaching and Learning*, 2008(114), 5-15.
- Watts, M. M. (2005). The place of the library versus the library as place. In M. L. Upcraft, J. N. Gardner, & B. O. Barefoot (Eds.), *Challenging and supporting the first-year student: A handbook for improving the first year of college*, (pp. 339-355). Indianapolis, IL: Jossey-Bass.
- Weinberg, C. B. (1974). University library: Analysis and proposals. *Management Science*, 21(2), 130-140.

- Williams, A. P. (1995). Conceptualizing academic library use: Results of a survey of continuing education undergraduates in a small Canadian undergraduate university. *Canadian Journal of Higher Education*, 25(3), 31-48.
- Wong, S. H. R., & Cmor, D. (2011). Measuring association between library instruction and graduation GPA. *College & Research Libraries*, 72(5), 464-473.
- Wong, S. H. R., & Webb, T. D. (2011). Uncovering meaningful correlation between student academic performance and library material usage. *College & Research Libraries*, 72(4), 361-370.

Appendix – Reference Counts and Authorship for Articles Included in Analysis

Author (Year)	Title	Number of Non-LIS References	Number of LIS References	Number of references	Non-LIS Co-author or Non-LIS Collaborator
Allison, 2015	Measuring the academic impact of libraries	4 (24%)	13 (76%)	17	
Black & Murphy, 2017	The out loud assignment: Articulating library contributions to first-year student success	13 (59%)	9 (41%)	22	
Bowles-Terry, 2012	Library instruction and academic success: A mixed-methods assessment of a library instruction program	1 (9%)	10 (91%)	11	Non-LIS collaborator
Catalano & Phillips, 2016	Information literacy and retention: A case study of the value of the library	5 (16%)	26 (84%)	31	Non-LIS co-author as 2 nd author; Non-LIS collaborators; AiA
Çetin & Howard, 2016	An exploration of the relationship between undergraduate students' library book borrowing and academic achievement	15 (39%)	23 (61%)	38	Non-LIS authors
Cherry, Rollins, & Evans, 2013	Proving our worth: The impact of electronic resource usage on academic achievement	1 (7%)	14 (93%)	15	Non-LIS co-author as 3 rd author
Chiteng Kot & Jones, 2015	The impact of library resource utilization on undergraduate students' academic performance: A propensity score matching design	25 (78%)	7 (22%)	32	Non-LIS co-author as 1 st author
Cook, 2014	A library credit course and student success rates: A longitudinal study	1 (6%)	17 (94%)	18	
Cox & Jantti, 2012	Capturing business intelligence required for targeted marketing, demonstrating value, and driving process improvement	2 (11%)	16 (89%)	18	Non-LIS collaborators
Crawford, 2014	Pennsylvania academic libraries and student retention and graduation	3 (25%)	9 (75%)	12	
Crawford, 2015	The academic library and student retention and graduation: An exploratory study	4 (24%)	13 (76%)	17	
Emmons & Wilkinson, 2011	The academic library impact on student persistence	14 (58%)	10 (42%)	24	

Eng & Stadler, 2015	Linking library to student retention: A statistical analysis	11 (44%)	14 (56%)	25	
Goodall & Pattern, 2011	Academic library non/low use and undergraduate student achievement a preliminary report of research in progress	6 (32%)	13 (68%)	19	
Haddow & Joseph, 2010	Loans, logins, and lasting the course: Academic library use and student retention	7 (27%)	19 (73%)	26	Non-Librarian co-author as 1 st author
Haddow, 2013	Academic library use and student retention: A quantitative analysis	27 (54%)	23 (46%)	50	Non-Librarian author
Kinsley, Hill, & Maier-Katkin, 2014	A research and class model for future library instruction in higher education	11 (41%)	16 (59%)	27	Non-LIS co-authors as 2 nd and 3 rd authors
Massengale, Piotrowski, & Savage, 2016	Identifying and articulating library connections to student success	2 (20%)	8 (80%)	10	Non-LIS collaborators; AiA
Mezick, 2015	Relationship of library assessment to student retention	12 (30%)	28 (70%)	40	
Montenegro et al., 2016	Library resources and students' learning outcomes: Do all the resources have the same impact on learning?	8 (42%)	11 (58%)	19	Non-LIS co-authors as 1 st -7 th authors
Murray, Ireland, & Hackathorn, 2016	The value of academic libraries: Library services as a predictor of student retention	10 (37%)	17 (63%)	27	Non-LIS co-author as 3 rd author
Odeh, 2012	Use of information resources by undergraduate students and its relationship with academic achievement	7 (33%)	14 (67%)	21	Non-librarian author
Renaud, Britton, Wang, & Ogihara, 2015	Mining library and university data to understand library use patterns	2 (13%)	13 (87%)	15	Non-LIS co-authors as 3 rd and 4 th authors; Non-LIS collaborators
Samson, 2014	Usage of e-resources: Virtual value of demographics	2 (15%)	11 (85%)	13	Non-LIS collaborator
Scarletto, Burhanna, & Richardson, 2013	Wide awake at 4 am: A study of late night user behavior, perceptions and performance at an academic library	4 (33%)	8 (67%)	12	
Scott, 2014	Interlibrary loan article use and user gpa: Findings and implications for library services	0 (0%)	8 (100%)	8	
Soria, Fransen, & Nackerud, 2013	Library use and undergraduate student	12 (41%)	17 (59%)	29	Non-LIS co-author as 1 st author

	outcomes: New evidence for students' retention and academic success				
Soria, Fransen, & Nackerud, 2014	Stacks, serials, search engines, and students' success: First-year undergraduate students' library use, academic achievement, and retention	17 (38%)	28 (62%)	45	Non-LIS co-author as 1 st author
Soria, Fransen, & Nackerud, 2017a	Beyond books: The extended academic benefits of library use for first-year college students	9 (43%)	12 (57%)	21	Non-LIS co-author as 1 st author
Soria, Fransen, & Nackerud, 2017b	The impact of academic library resources on undergraduates' degree completion	12 (34%)	23 (66%)	35	Non-LIS co-author as 1 st author
Squibb & Mikkelsen, 2016	Assessing the value of course-embedded information literacy on student learning and achievement	3 (14%)	19 (86%)	22	Non-LIS collaborators; AiA
Stemmer & Mahan, 2015	Assessing the library's influence on freshman and senior level outcomes with user surveys	3 (23%)	10 (77%)	13	Non-LIS co-author as 2 nd author
Stemmer & Mahan, 2016	Investigating the relationship of library usage to student outcomes	6 (23%)	20 (77%)	26	Non-LIS co-author as 2 nd author
Stone & Ramsden, 2013	Library impact data project: Looking for the link between library usage and student attainment	6 (18%)	27 (82%)	33	Unable to Determine
Teske, DiCarlo, & Cahoy, 2013	Libraries and student persistence at southern colleges and universities	3 (13%)	21 (88%)	24	Non-LIS co-author as 3 rd author; Non-LIS collaborator
Thorpe, Lukes, Bever, & Yan He, 2016	The impact of the academic library on student success: Connecting the dots	2 (13%)	14 (88%)	16	Non-LIS collaborator
Vance, Kirk, & Gardner, 2012	Measuring the impact of library instruction on freshman success and persistence	3 (30%)	7 (70%)	10	
Wong & Cmor, 2011	Measuring association between library instruction and graduation GPA	4 (17%)	20 (83%)	24	Non-LIS collaborator
Wong & Webb, 2011	Uncovering meaningful correlation between student academic performance and library material usage	3 (20%)	12 (80%)	15	Non-LIS collaborator
		280 (32%)	600 (68%)	880	

Note. Non-LIS co-author means that the author's primary appointment is in a field other than LIS. Non-librarian author means that the author is a faculty in LIS, rather than a practicing librarian. Non-LIS

collaborator is a person mentioned in the acknowledgements or the text of the article who does not have a primary affiliation with LIS. AiA stands for an Assessment in Action project.