

Survey of Research in Engineering Librarianship, 2015-2019

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Abstract

This work-in-progress research study aims to examine what research was conducted pertaining to engineering librarianship from 2015-2019 (pre-pandemic) with a particular focus on methodology. Peer-reviewed articles published between 2015-2019 were surveyed to identify who is performing research in engineering librarianship, what research methods are being used, if the studies are repeatable, and if the methods chosen are appropriate for the research question under investigation. Each paper that matched the inclusion criteria was examined and information was extracted relating to authorship, journal published in, research design, method, and analysis, as well as research question and instrument (when relevant). Simple statistical analysis will be conducted to derive patterns around research papers in engineering librarianship during this 5-year period. This paper will report the in-progress results of this comprehensive literature review.

Introduction

This project began in 2019. While it is still a work in progress, the authors wanted to focus on the methodology chosen to undertake this study, as well as the current status of the research being conducted. The topic itself arose from several conversations at the 2019 ASEE conference in Tampa where the authors were curious about the landscape of engineering librarianship publications, focusing on what research methods were typically being used by engineering librarians in their research and how appropriate and well were these approaches being explained. Explorations of the types of studies typically conducted by librarians has been discussed, studied and editorialized from many years [1]–[4] but the focus in most of the papers examined seemed to be more on the profession of librarianship rather than on Engineering librarianship specifically. It is worth noting that the authors were curious whether the choice of research methods would differ across multiple disciplines but determined that to be out of the scope of this research paper.

Creating the research questions

Review of previous literature

As with most studies, the authors' first step was to determine what work on this topic had already been conducted. Kloda et al. [5] explored the strengths and weaknesses of research in library and information studies by reviewing evidence summaries in the journal *Evidence Based Library and Information Practice*. While it was interesting to see a compilation of the weaknesses identified in the evidence summaries, the sample was limited to only the research that had made it to review by *Evidence Based Library and Information Practice*, presumably research which was of a high enough quality to reach this level.

The next step in designing the research question for this paper was to examine checklists or inventories that reviewed research in library and information science. Eldredge [6] provides an inventory of research methods most frequently used in library and information studies, but does not provide guidance for assessing the quality of these methods. A well-known checklist based on Evidence-Based Librarianship (EBL) that does assess quality is provided by Glynn [7]. This checklist is exhaustive and provides a final score. It should be noted that Booth [8], [9] advocates against using scoring and critical appraisal checklist as they are focused entirely on the presence or absence of features and fail to acknowledge that sometimes a poorly designed study may yield valuable insights while a well-conducted one may lack originality or creative ideas.

The authors next examined articles that might model the methodology of the type of content analysis that was of interest to this study. Aytac and Slutsky [10] examined papers published in two journals *Library Trends* and *Issues in Science and Technology Librarianship*. They examined whether articles qualified as research, the subject, authorship, and methodologies used in the articles. Although this content analysis provided a description of research in librarianship without assessing the quality of the studies, it provided a model for information that should be considered in the evaluation of research being conducted. Fiegen [11] took the approach of conducting a bibliographic search for research, instead of sampling specific journals, before applying a checklist based on Eldredge [6] and Glynn [7]. Koufogiannakis et al. [12] also conducted a content analysis of librarianship research and their approach to categorization and to critical appraisal, while looking at a broad spectrum of disciplines, was useful in helping to conceptualize the types of information that would best help design and answer the research questions that follow.

The research questions

The following objectives and research questions stemmed from the authors' examination of previous work that touched on aspects of the area of interest identified, what methodologies are typically being used in the research literature relevant to engineering librarianship.

Objective 1: To identify who is performing research in engineering librarianship.

Associated Research Questions: What countries are authors from? What percentage of articles involve international collaboration? How many authors typically collaborate on a single article? Where are most researchers employed? What are the primary journals where authors choose to publish?

Objective 2: To identify the research methods used in engineering librarianship.

Associated Research Questions: What is the most common research design, method, and analysis?

Objective 3: To investigate the quality of research being performed in engineering librarianship.

Associated Research Questions: Do researchers clearly explain their methods? Can studies be repeated? Are the methods used appropriate to the research question? Is the research question being investigated clearly articulated? Is an instrument included when relevant?

Tackling the research questions

Objective 1: To identify who is performing research in engineering librarianship.

As the authors began to design the search strategy to work on the first objective and its associated research questions, it was realized that this was trickier than anticipated. Engineering librarians publish in many different places, including both library and engineering focused journals, so it was not straightforward to identify relevant papers. An email was sent to the ELD listserv on May 22, 2020 to see if collective wisdom of engineering librarian peers might offer some insights (see figure 1.)

Dear collective ELD wisdom,

We are attempting to identify ALL of the literature written by engineering librarians in the last five years.

We've tried the use of a search string in key databases such as:
librar* AND engineering AND (academic OR higher education OR college OR university)

We've also considered targeting selected journals from Engineering Education and LIS.

But we feel that neither approach is quite right. The results are either too broad (containing unrelated mentions of libraries) or too narrow (excluding works that are published in interdisciplinary settings). We are especially concerned about missing articles from outside North America.

We feel that there is just something missing in our approach...

How would you all tackle this task?

Sincerely, Mindy Thuna and Amber Janssen

Figure 1. Email to the ELD listserv on May 22, 2020.

Two relevant responses were received. One started with “Yeah, you two, good luck with that.” And ended with “As for how I would tackle that task – I’d run screaming the other direction, in search of a tasty beer, scotch or tequila... But in all seriousness, I think your proposed task is borderline impossible.” Thankfully the middle of the response was filled with multiple useful suggestions, with the key ones being that position titles would not be a good source of information as not all engineering librarians have the word “engineering” in their titles and a recommendation to ensure the authors included Google Scholar to find articles written by engineering librarians that might be broader in scope and include, e.g., scholarly communication or research data management type topics. The second respondent also pointed to Google Scholar and recommended the Google Scholar profile created by an ELD committee of members who submitted their publications – while acknowledging this resource was in need of an update, it was recommended as an easier route than searching through a list of engineering librarians from ASEE or SLA and then pulling out names to contact or running those names through several databases. Conversations on how to proceed led the authors to consider a different approach, focusing not so much at the onset on whether the authors were engineering librarians but rather on whether the content would be of relevance to engineering librarianship. And so the database searching began.

Table 1 outlines the databases searched and the search strings used. The following limiters/filters were applied: date range, format and language. A date range for publications from January 2015 to December 2019 was chosen to examine a 5-year pattern (the research project was started in 2020 so the last full year of possible publications was 2019). It is worth flagging that this coincided with the beginning of the COVID-19 pandemic, which has modified research and publishing patterns.

Journal articles and conference proceedings were originally planned as the formats to be examined but as the research proceeded it was determined that a) there was sufficient material to examine the patterns focusing only on the journals and b) that publishing in conference venues was potentially different enough to warrant a separate study. Finally, as neither of the authors was fluent enough in other languages to warrant including them, only articles published entirely in English were included, i.e. an English abstract alone was insufficient for a study to be included. This filter was applied inconsistently by the database vendors so some of the original numbers include papers that were written in a language other than English but included an English abstract. These items were removed from the study as they were discovered.

Two tools were used to help facilitate working with the papers, Zotero, a free reference management tool, and Covidence, a subscription screening and data extraction tool. Once the searching was completed, the results were uploaded to a shared Zotero library. The Duplicate Items feature was used to remove duplicate results. Deduplication was repeated when the titles were uploaded to Covidence to remove any that had escaped detection.

While this research was not a systematic review, some of the methodological pieces from this intense search methodology were applied to ensure the repeatability of the work by other researchers. To this end a simplified PRISMA flow diagram was created to clearly illustrate the identification of studies for the analysis (Figure 2.)

Table1. Databases searched and search parameters used.

Database	Date Searched	n (records) =	Search string with syntax used
Compendex – Engineering Village	6/12/2020	5,934	((librar* AND engineer* AND (academic OR "higher education" OR college or university OR post*secondary)) WN ALL) AND (JA WN DT) AND (English WN LA) Limited to 2015-2019
EBSCO – Library, Information Science & Technology Abstracts (LISTA)	6/12/2020	906	librar* AND engineer* AND (academic OR "higher education" OR college or university OR post*secondary) <i>Limiters</i> Publication Date: 20150101-20191231 Publication Type: Academic Journal Document Type: Article Language: English
EBSCO – Library Literature & Information Science Full Text (H.W.Wilson)	6/17/2020	724	librar* AND engineer* AND (academic OR "higher education" OR college or university OR post*secondary) <i>Limiters</i> Publication Date: 20150101-20191231 Publication Type: Academic Journals

Database	Date Searched	n (records) =	Search string with syntax used
			Document Type: Article Narrow by Language: English
Proquest – Library & Information Science Abstracts (LISA)	6/17/2020	2,786	librar* AND engineer* AND (academic OR "higher education" OR college OR university OR post*secondary) <u>Limits:</u> Date: From January 01 2015 to December 31 2019 Source type: Scholarly Journals Document type: Article Language: English
Elsevier – Scopus	6/17/2020	455	TITLE-ABS-KEY (librar* AND engineer* AND (academic OR "higher education" OR college OR university OR post*secondary)) AND (LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j"))
Clarivate – Web of Science Core Collection	6/17/2020	170	TOPIC: (librar* AND engineer* AND (academic OR "higher education" OR college OR university OR post*secondary)) Refined by: LANGUAGES: (ENGLISH) AND DOCUMBER TYPES : (ARTICLE) Timespan: 2015-2019 Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ECSI

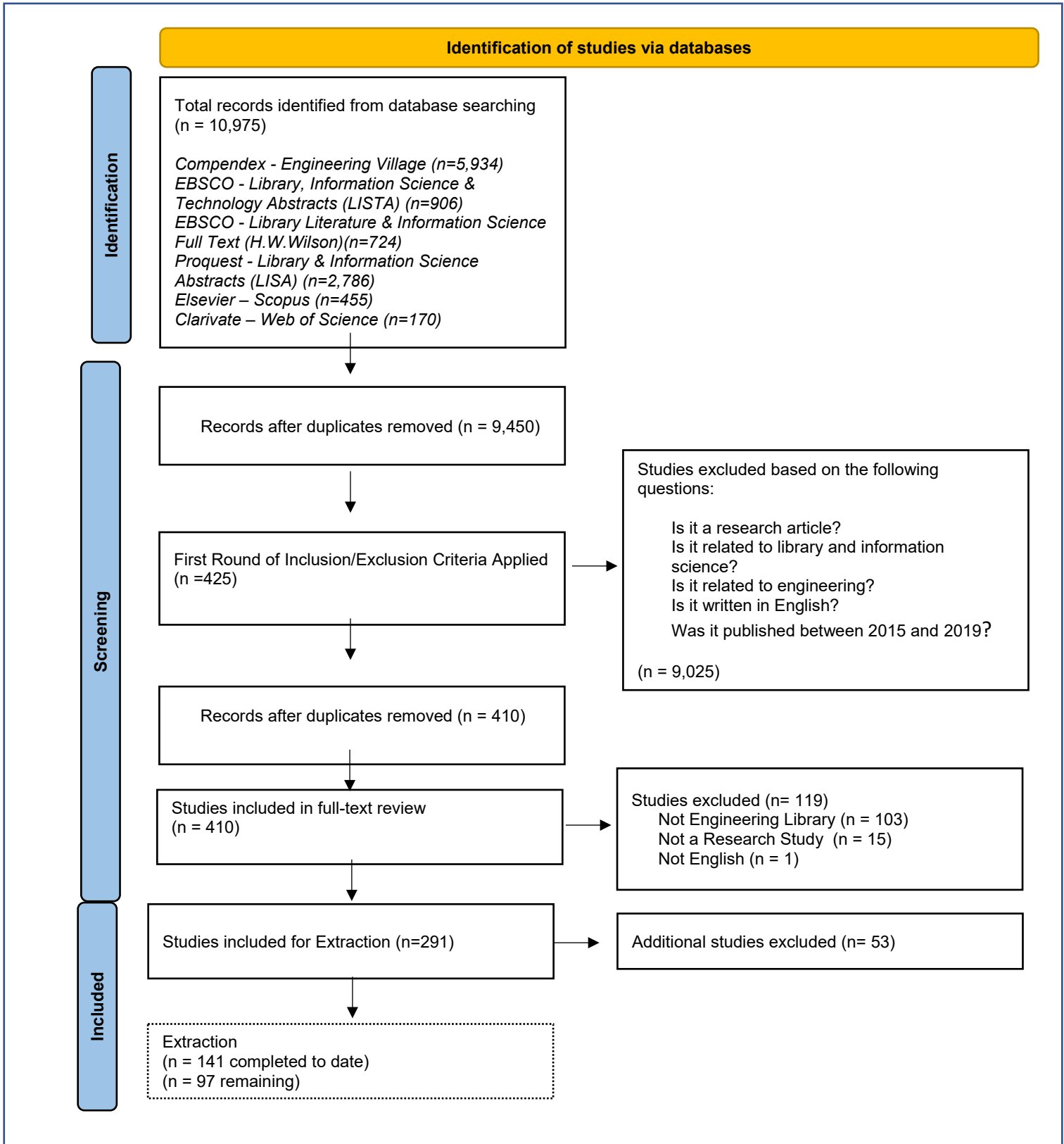


Figure 2. Modified PRISMA diagram [13] outlining the process used.

Objective 2: To identify the research methods used in engineering librarianship.

When the second research question was designed, to examine the research designs, methods and analysis used, it seemed quite straightforward as the intention was to use checklist type questions that could be analyzed with simple descriptive statistics – mean, mode, etc. Instead as data extraction was conducted it became clear that before research methods could be identified, it was necessary to first ensure that the authors of this paper had the same understanding of the difference between research design, method and analysis. It became clear very quickly how convoluted and messy it could get if researchers were working from different definitions and if this paper’s authors did not work from the same place. The three key categories from the literature were mapped to maintain continuity and accuracy when extracting and assessing the results. A few key reference guides were used and definitions were pared down to a quick referral guide that was used consistently when extracting data from the papers that matched the inclusion criteria. It should be noted that while this worked most of the time, case studies have proven to still be confusing as many people refer to their research method as a case study when it is not necessarily true based on the definitions as defined in Table 3. More information was added to the extraction documentation to ensure greater consistency in the use of these categories once the guideline was completed. Tables 2, 3 and 4 outline the final set of definitions used in this study.

Table 2. Definitions used to differentiate between research approaches from Creswell and Creswell [14].

<p><i>Qualitative research</i> is an approach that involves the examination of how individuals and groups understand/approach a problem. Data is usually collected in the subject’s setting and analysis often involves the creation of themes and interpretation by the researcher of the meaning of the collected data.</p>
<p><i>Quantitative research</i> is an approach that makes inferences about relationships among variables and tests objective theories by examining these relationships. The data collected is typically numerical and can be analysed using statistical tests. Often the results from a sample are generalized to a broader population.</p>
<p><i>Mixed methods research</i> collects both quantitative and qualitative data and integrates the results of both. The central tenet of this approach is that greater insight is garnered by including the two approaches.</p>

Table 3. Most commonly used research designs for each of the three research approaches: qualitative, quantitative, and mixed methods.

<i>Qualitative Research Designs</i>
<u>Narrative</u> research investigates the lives of individuals through stories, which are then molded by the researcher into a narrative chronology (modified from Creswell & Creswell [14]).
<u>Phenomenological</u> research usually involves interviewing individuals about their lived experiences of a phenomenon (modified from Creswell & Creswell [14]).
<u>Grounded Theory</u> is a method of inquiry that involves iterative stages of simultaneous data collection and analysis culminating in a final theoretical explanation from the empirical evidence (modified from Bryant & Charmaz [15]).
<u>Ethnography</u> involves the study of “the shared patterns of behaviours, language, and actions of an intact cultural group in a natural setting over a prolonged period of time. Data collection often involves observation and interviews.” (Creswell & Creswell [14]).
<u>Case Studies</u> involves an “in-depth analysis of a case, often a program, event, activity, process or one or more individuals. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time.” (Creswell & Creswell [14]).
<i>Quantitative Research Designs</i>
<u>Surveys</u> are used to produce numerical descriptions about an aspect, often trends, attitudes, or opinions, of a study population. Surveys usually involve asking questions followed by analysis of the responses. Data is generally collected from a sample of the population with the intent being to generalize the findings to the larger population (from Fowler [16]; Creswell & Creswell [14]).
<u>Experimental</u> research “seeks to determine if a specific treatment influences an outcome. The researcher assesses this by providing a specific treatment to one group and withholding it from another and then determining how both groups scored an outcome” (Creswell & Creswell [14]).
<i>Mixed Methods Research Designs</i>
<u>Convergent</u> design typically collects both qualitative and quantitative data at the same time and results are merged for interpretation. Any findings that are anomalous or contradictory are then explained or further explored. (modified from Creswell & Creswell [14]).
<u>Explanatory sequential</u> research starts with quantitative data collection and analysis. The results are probed further by a secondary collection of qualitative data and analysis (modified from Creswell & Creswell [14]).
<u>Exploratory sequential</u> starts with a qualitative data collection and analysis phase. The analysis is then used to build the second quantitative phase of data collection and analysis (modified from Creswell & Creswell [14]).

Table 4. Most commonly used research methods for each of the three research approaches: qualitative, quantitative, and mixed methods.

<i>Qualitative research</i>
<u>Observation</u> – “researcher takes field notes on the behaviour and activities of individuals at the research site... Typically these observations are open-ended in that the researchers ask general questions of the participants allowing the participants to freely provide their views.” (Creswell & Creswell [14]).
<u>Interviews</u> – “researcher conducts face to face interviews with participants, telephone interviews or engages in focus group interviews... These interviews involve unstructured and generally open-ended questions that are few in number and intended to elicit views and opinions from the participants.” (Creswell & Creswell [14]).
<u>Documents</u> – Documents collected during the process of research may be public or private items (Creswell & Creswell [14]).
<u>AV and Digital Material</u> – This type of material can take many different forms, including social media materials, photographs, art objects, videotapes, websites, emails, text messages, or any form of sound recordings (Creswell & Creswell [14]).
<i>Quantitative research</i>
<u>Survey Design</u> – “Survey designs help researchers answer three types of questions: a) descriptive questions (e.g. What % of practicing nurses support the provision of hospital abortion services; b) questions about the relationships between variables (e.g. is there a positive association between endorsement of hospital abortion services and support for implementing hospice care among nurses?); or in cases where a survey design is repeated over time in a longitudinal study; c) questions about predictive relationships between variables over time (e.g. Does Time 1 endorsement of support for hospital abortion services predict greater Time 2 burnout in nurses?)”(Creswell & Creswell [14]).
<u>Experimental Design</u> – “An experimental design systematically manipulates one or more variables in order to evaluate how the manipulation impacts an outcome (or outcomes?) of interest...An experiment isolates the effects of this manipulation by holding all other variables constant.”(Creswell & Creswell [14]).
<i>Mixed methods research</i>
Any combination of methods outlined for Qualitative and Quantitative research

Objective 3: To investigate the quality of research being performed in engineering librarianship. This final objective is the most subjective of the ones being explored. One clear way to determine how well someone has described their methodology is to ask whether or not it could be repeated. A key feature of the scientific method is the reproducibility of a study – usually to generate identical results. In this article, an assessment of whether the results could be reproduced was not the goal but instead whether the method was explained with sufficient detail and clarity to be repeated. Part of this repetition, for some methodologies, would require the instrument used be made available so this was another piece of evidence that was looked for. A final measure of quality was how well the question being investigated and the method chosen to

examine the question matched – this allowed for an assessment of whether the methods chosen were logical approaches to answer what was being investigated.

Applying the inclusion and exclusion criteria

After combining and deduplicating the results of the original searches in Zotero, records were exported to an Excel spreadsheet. Each paper was independently reviewed using only the title and abstract as the basis for determining if they would be included dependent on the following criteria:

- Is it a research article?
- Is it related to library and information science?
- Is it related to engineering?
- Is it written in English?
- Was it published between 2015 and 2019?

Any articles that were not agreed upon were discussed until consensus was reached. There were 425 resulting articles that matched all criteria for inclusion.

An Excel spreadsheet was created and each included article was assigned a unique identifier. Five more duplicates were identified during this process. Retrieval of the full -text of the 420 articles was attempted and a shared drive was created to store them. Each item was labeled with its unique identifier. Two articles were removed at this point as one was not found written in English while the other proved to be another duplicate. Four hundred and eighteen articles were now the sample being investigated.

An attempt was started to extract the following information from the 418 articles:

- Is this a research study? (Y/N)
- Is this engineering library related (Y/N)?
- Title of article
- Year of publication
- Name of authors
- Number of authors
- Affiliation
- Country of origin
- Publication title
- Hypothesis or research question (cut and paste from article)

- Research methodology: systematic review, case study, unclear, etc.
- Methodology clearly explained (Y/N)
- Included instrument (Y/N)
- Branch of engineering (mechanical, engineering education, civil, STEM, etc.)
- Data analysis technique

This is the point where it was determined that more formal definitions for research methodology were needed (see Objective 2 above). After grappling with this and creating a cheat sheet of research methodologies, the process of seeking consensus for each item and its data was restarted. It quickly became clear that the excel spreadsheet was adequate but not the most effective process. A common tool used for Knowledge Synthesis projects, Covidence, seemed like a tool worth exploring to help improve efficiency for this part of the project. The 418 full-text articles were uploaded into Covidence and another 8 duplicates were identified. The full-text of the remaining 410 articles were reviewed for inclusion using the same criteria as had been applied to the abstract review phase:

- Is it a research article?
- Is it related to library and information science?
- Is it related to engineering?
- Is it written in English?
- Was it published between 2015 and 2019?

From this stage 119 articles were excluded leaving 291 articles.

Extraction (the current phase of the research)

This is the current phase of the research. Data is being extracted from the full-text of the remaining 291 articles using the questions outlined in Figure 3.

Descriptive Information
Study ID
Title of Paper
Year
Publication Title
Last name of first author
Author affiliation
Country of author affiliation(s)
Characteristics of Included Studies
Methods
Hypothesis or Research Question: Is a hypothesis or research question stated
Research Approach
Research Design
Research Method 1
Research Method 2
Data Analysis Technique
Participants
Branch of Engineering
Group being investigated
Sample Size
Thing sampled
Quality Assessment
Is the methodology clearly explained? Can the study be reproduced?
Does the methodology match the research questions?
Is the instrument included
Methodology Notes
Second guessing: Is this an engineering library research paper?

Figure 3. Guiding questions used for extraction phase.

During the process of consensus and a more thorough reading of the full-text articles, the scope of the study was modified from the original requirement that the research question or sample population be related or relevant to engineering to the need for articles to include results specifically related to engineering librarianship. Many articles reported out results that lumped engineering into STEM or other categories and they were deemed to be too broad and not in the true spirit of exploring the research of engineering librarianship because the results or recommendations could not be directly applied to engineering libraries or engineering librarians without some level of interpretation.

To date, extraction is completed for 124 articles. An additional 41 articles have been excluded for not presenting disaggregated engineering librarianship results or for being identified as not being a research paper. There are 126 articles remaining for extraction.

Next Steps

Upon completion of the extraction, data analysis will commence. The intention is to present the final results in a peer-reviewed journal article and potentially repeat the study for 2020-2024 to examine the effect that the COVID-19 pandemic may have had.

Lessons Learned

All of the problems encountered during this research project are fairly typical. There were setbacks in defining the scope of the project; challenges in identifying a research methodology; revisions to the research objectives and questions; and a change to the tools with the discovery that they were not the best suited for the methodology. Perhaps the authors should have listened to the very sound advice that they received at the beginning “run screaming in the other direction, in search of a tasty beer, scotch or tequila”, but then the authors would not have had the first-hand experience of just how long a project like this takes to complete.

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