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An Environmental Scan of Bibliometrics and Research Impact Open Instructional Trends at Canadian Academic Research Libraries

Megan Palmer, Laura Bredahl et Kari D. Weaver

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Résumé de l'article

Alors que la bibliométrie est utilisée depuis des années dans le milieu universitaire, de récentes conversations sur son utilisation responsable ont suscité un besoin de mieux comprendre la bibliométrie et l'impact de la recherche au sein de la communauté universitaire. Les bibliothécaires universitaires sont des personnes idéales pour contribuer à l'enseignement de la bibliométrie, car iels sont déjà intégré.e.s au processus scientifique de leur communauté universitaire et connaissent souvent les outils pertinents et leurs fonctions. Le but de cette analyse contextuelle était d'évaluer l'état actuel du matériel pédagogique ouvert pour la bibliométrie et l'impact de la recherche dans les établissements universitaires membres de l'Association des bibliothèques de recherche du Canada (ABRC). Une analyse contextuelle des guides de recherche a été choisie comme méthodologie pour cette étude. Les résultats de cette analyse indiquent que 97 % (28/29) des établissements universitaires membres de l'ABRC détenaient au moins un guide de recherche lié à la bibliométrie et l'impact de la recherche sur un total de 56 guides étudiés. Une analyse des mots clés a révélé que parmi les guides étudiés, les mots clés liés aux outils et méthodologies de bibliométrie et l'impact de la recherche étaient discutés à la fréquence la plus élevée (présents dans 96 % des guides), tandis que les mots clés liés aux indicateurs responsables et alternatifs étaient discutés à la fréquence la plus faible (présents dans 38 % des guides). Les résultats de cet article profiteront 1) aux bibliothécaires en exercice qui créent ou mettent à jour leurs propres guides de bibliométrie et d'impact de la recherche ou développent des formations en bibliothèque sur des sujets connexes et 2) à la planification stratégique et à la gouvernance au sein des établissements universitaires et plus largement au niveau national en révélant les tendances des services et ressources de bibliométrie et d'impact de la recherche dans le contexte canadien.

An Environmental Scan of Bibliometrics and Research Impact Open Instructional Trends at Canadian Academic Research Libraries

Megan Palmer
SUNY Oneonta

Laura Bredahl
University of Waterloo

Kari D. Weaver
University of Waterloo

ABSTRACT

While bibliometrics have been used for years in academia, recent conversations into their responsible use have driven a need for greater understanding of bibliometrics and research impact within the academic community. Academic librarians are ideal individuals to contribute to instruction on bibliometrics, as they are already embedded within their academic community's scholarly processes and are often familiar with relevant tools and their functions. The purpose of this environmental scan was to evaluate the current state of open instructional materials for bibliometrics and research impact at the Canadian Association of Research Libraries (CARL) academic member institutions. An environmental scan of research guides was chosen as a methodology for this study. Results of this scan identify that 97% (28/29) of CARL academic member institutions held at least one research guide related to bibliometrics and research impact, in a total of 56 guides reviewed. A keyword analysis revealed that of the guides reviewed, keywords related to tools and methodologies of bibliometrics and research impact were discussed at the highest frequency (present within 96% of guides), while keywords related to responsible and alternative metrics were discussed at lowest frequency (present within 38% of guides). Results of this article will benefit 1) practicing librarians who are creating or updating their own bibliometrics and research impact guides or developing library instruction on related topics and 2) strategic planning and governance within academic institutions and more broadly at the national level by revealing trends in bibliometrics and research impact services and resources in the Canadian context.

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Keywords: *alternative metrics · bibliometrics · library instruction · research guides · research impact*

RÉSUMÉ

Alors que la bibliométrie est utilisée depuis des années dans le milieu universitaire, de récentes conversations sur son utilisation responsable ont suscité un besoin de mieux comprendre la bibliométrie et l'impact de la recherche au sein de la communauté universitaire. Les bibliothécaires universitaires sont des personnes idéales pour contribuer à l'enseignement de la bibliométrie, car iels sont déjà intégré.e.s au processus scientifique de leur communauté universitaire et connaissent souvent les outils pertinents et leurs fonctions. Le but de cette analyse contextuelle était d'évaluer l'état actuel du matériel pédagogique ouvert pour la bibliométrie et l'impact de la recherche dans les établissements universitaires membres de l'Association des bibliothèques de recherche du Canada (ABRC). Une analyse contextuelle des guides de recherche a été choisie comme méthodologie pour cette étude. Les résultats de cette analyse indiquent que 97 % (28/29) des établissements universitaires membres de l'ABRC détenaient au moins un guide de recherche lié à la bibliométrie et l'impact de la recherche sur un total de 56 guides étudiés. Une analyse des mots clés a révélé que parmi les guides étudiés, les mots clés liés aux outils et méthodologies de bibliométrie et l'impact de la recherche étaient discutés à la fréquence la plus élevée (présents dans 96 % des guides), tandis que les mots clés liés aux indicateurs responsables et alternatifs étaient discutés à la fréquence la plus faible (présents dans 38 % des guides). Les résultats de cet article profiteront 1) aux bibliothécaires en exercice qui créent ou mettent à jour leurs propres guides de bibliométrie et d'impact de la recherche ou développent des formations en bibliothèque sur des sujets connexes et 2) à la planification stratégique et à la gouvernance au sein des établissements universitaires et plus largement au niveau national en révélant les tendances des services et ressources de bibliométrie et d'impact de la recherche dans le contexte canadien.

Mots-clés : *bibliométrie · enseignement en bibliothèque · guides de recherche · impact de la recherche · indicateurs alternatifs*

Bibliometrics and research impact are large overarching topics which in this study will refer to the emerging skills and foci of academic librarians who contribute to bibliometric analysis and services within their academic communities. Bibliometrics are defined as "the study of academic publishing that uses statistics to describe publishing trends and to highlight relationships between published works" (Ninkov, Frank, and Maggio 2021, 173). Bibliometrics include traditional measures to evaluate impact, such as the h-index, journal impact factor, or citation counts (Sutton, Miles, and Konkiel 2018). Although bibliometric measures have been used dating back to the 1960s, more recently there has been a move away from strictly using metrics-based evaluation for research impact (Cox et al. 2019; Hicks et al. 2015; Malone and Burke 2016; Nix and Smith 2019). To address this move, discussions of the responsible use of metrics are used to educate about utilizing bibliometrics "in a more balanced and

fairer" way to understand the impact of research (Cabezas-Clavijo and Torres-Salinas 2021, 2).

Wilsdon (2016a) defines responsible metrics as the consideration of a "number of dimensions," while using metrics including, "robustness… humility… transparency… diversity… [and] reflexivity" (138). The responsible use of metrics movement has been amplified through best practice publications, which now guide the appropriate use of metrics in a responsible manner (Bredahl 2022; Hicks et al. 2015; DORA n.d.; INORMS Research Evaluation Group 2020). Alternative metrics or 'alt-metrics' have also been suggested as a complimentary set of measures to the strictly scholarly article citation-based impact, which "records scientific output from online sources" (Fühles-Ubach, Albers, and Neumann 2021, 476). These outputs include mentions across various platforms including, "social media… reference managers… expert peer review and recommendation services… main stream media and public policy documents" (Sutton, Miles, and Konkiel 2018, 34). Author disambiguation is an additional facet of scholarly communication which allows for authors to be identified through a unique author identifier number (Nix and Smith 2019). Author identification specifically, "improv[es]… visibility and accuracy of an author's attributed publications" (Nix and Smith 2019, 263), and is often interlaced with conversations of bibliometrics and research impact, as is seen within the results of this environmental scan.

Although the above concepts may appear to be diverse, they are all prominent within scholarly publishing and in the work of the academic librarians who support researchers in the scholarly process (Cox et al. 2019). Librarians within these research support roles contribute to their academic community's understanding of bibliometrics and research impact, or their "bibliometric literacy" (Cox et al. 2019, 748), through creation of online content on bibliometrics, research impact, alternative metrics, responsible use of metrics, and author identification. A primary pathway of library content sharing and instruction from librarians to their academic communities includes online instructional material (Bergstrom-Lynch 2019). Historically, this asynchronous learning need was met with print pathfinders (Vileno 2007). As easy-to-use website creation tools, such as Springshare's LibGuides, have become widely available and accessible to librarians, these pathfinders have evolved into the online research guides that we know today (Bergstrom-Lynch 2019; Vileno 2007; Vaska and Vaska 2017). As such, openly available online instructional content, in the form of research guides related to bibliometrics and research impact, is the primary focus of this study.

In May of 2022, as a team from the University of Waterloo Library, we began the instructional design process to create a suite of bibliometrics modules which aimed to increase the bibliometric literacy of their academic community. Within

this instructional design process, we conducted an informal environmental scan to identify what types of information were discussed within peer institutions' openly available bibliometrics and research impact online instructional content. The initial scan revealed that bibliometrics and research impact content were held on research guides, which have been identified as a primary pathway of instruction by librarians to their academic communities. Due to the time commitment of gathering these data and lack of current information on the topic, we opted to formalize the project with intention to publish this article. Therefore, we pivoted to a formal environmental scan methodology, implementing a clear workflow, research questions, and a plan for data collection. The research questions that drove this environmental scan include:

1. What is the current state of bibliometrics instructional content at CARL institutions?
2. What types of resources are available from CARL institutions to provide online asynchronous instructional content for bibliometrics to university stakeholders in Canada?
3. What is the richness of instructional content on bibliometrics and research impact guides at CARL institutions?
4. What services do CARL institutions provide to their users to assist with bibliometrics inquiries and who specifically at each institution is providing those services?

This article provides a distinct overview of how a group of Canadian research-intensive university libraries are teaching bibliometrics and research impact to their academic communities through openly available online instructional content. Conclusions from this study outline the key topics and keywords present within these instruction materials, as well as identify the guide authors' positions, and level of interaction with the end users of the research guides. This study intends to provide an overarching state of the field on bibliometrics and research impact instruction in Canadian academic libraries through the lens of the end user. We hope that this research will assist libraries and their librarians in developing their own online instructional content for bibliometrics and research impact, serving their academic communities.

Literature Review

Bibliometrics and research impact have become a growing set of tools and processes within academia since their inception in the 1960s (Bredahl 2022). Defined in 2017 as "a nearly ubiquitous facet of scholarly communication" (Braun, 111), the specialization has seen an increase in popularity, utilization, and development in recent years (Cox et al. 2019; Sutton, Miles, and Konkiel 2018; Si et al. 2019; Corrall, Kennan, and

Afzal 2013). With this increased need for bibliometrics and research impact within academia, and its recognized connection to scholarly communication work, the role of an academic librarian is perfectly suited to provide bibliometrics and research impact services (Gumpenberger, Wieland, and Gorraiz 2011). Corrall, Kennan, and Afzal (2013) detailed that there is a gap between advanced bibliometrics competencies and the confidence of academic librarians to provide services and instruction on such tools and concepts. To meet this need, academic librarians must learn new skills in bibliometrics and research impact to allow them to stay relevant when serving their academic communities (Corrall, Kennan, and Afzal, 2013). Bibliometric competencies of academic librarians were explored in a study by Malone and Burke (2016), where the researchers concluded that librarians were more familiar and therefore confident with traditional metrics rather than alternative metrics. This finding was reiterated by Sutton, Miles, and Konkiel in 2018, where researchers identified that in their survey of the American Library Association (ALA) accredited Library and Information (LIS) schools in North America, teaching faculty were more familiar with "traditional measures of research impact" than alternative metrics (33). To meet the needs of an evolving landscape of academic librarianship, discussions surrounding LIS curriculum and professional development have been investigated (Fühles-Ubach, Albers, and Neumann 2021; Kennan, Corrall, and Afzal 2014; Nix and Smith 2019).

In response to such studies, Cox et al. (2019) detailed 99 core competencies that practicing academic librarians may be asked to perform when working within bibliometrics roles. Within these 99 core competencies, twelve larger themes were extrapolated from respondents' data, including,

> responsible use of metrics … applications of bibliometrics… metrics about scholars, units, institutions… metrics about journals… metrics about articles… metrics about impact… bibliometrics tools… data handling… training… system procurement… policy and strategy… [and] professional skills. (Cox et al. 2019, 750)

These bibliometric competencies will have implications within discussions regarding LIS curriculum, and the first seven themes of bibliometrics competencies are also valuable in discerning what topics should be addressed within instructional content by academic librarians to their institutional communities (Cox et al. 2019). The key competencies suggested by Cox et al. (2019), are mirrored in a study by Nix and Smith, where the successes of a research impact initiative at the University of Michigan, titled Research Impact Core are explored (2019). Key concepts discussed within the "Research by the Numbers" session outline of the Research Impact Core initiative include, "strengths and limitations of metrics… article metrics… alternative metrics… journal metrics… h-index…. [and] enhancing impact" (262). The core competencies as outlined by Cox et al. (2019), and session outline by Nix and Smith

(2019), will be examined further in this article to guide the key concepts that are expected to be found within this environmental scan of the CARL academic member's guides on bibliometrics and research impact.

Current offerings of bibliometrics and research impact guides at academic libraries have been explored through a variety of studies worldwide (Lewis, Sarli, and Suiter 2015; Si et al. 2019; Suiter and Moulaison 2015; Craft-Morgan 2023). These studies have evaluated various groups as datasets, including the Association of Research Libraries (ARL), Quacquarelli Symonds (QS) World Rankings, and Association of American Universities (AAU) (Lewis, Sarli, and Suiter 2015; Si et al. 2019; Suiter and Moulaison 2015; Craft-Morgan 2023). In 2015, the Scholarly Output Assessment Activities SPEC Kit was published by the ARL, which utilized survey methodology to University Librarians to provide a state of the field for research assessment activities at ARL institutions (Lewis, Sarli, and Suiter 2015). The SPEC Kit results outline that 96 percent, of respondent libraries provided research impact assessment services at their institutions, through library "guides, consultation, or education" (Lewis, Sarli, and Suiter 2015, 11). Additionally, Si et al. utilized website investigation methodology to scan website content for 76 of the Top 101 Universities as of the 2017 QS World University Rankings (2019). Si et al. (2019) explored the research support service offerings at these libraries and concluded that 42% of the libraries provided "research impact measurement" services to their campus communities (294). Further conclusions detailed seven specific libraries provided "outstanding expertise" in "research impact measurement" services, including two Canadian libraries: the University of Alberta, and the University of Toronto, both of which are also CARL members (Si et al. 2019, 294; Canadian Association of Research Libraries n.d.a). Suiter and Moulaison (2015) explored the library webpages of the 62 institutions within the AAU to determine what content was available for both traditional and non-traditional metrics, as well as research impact tools. The researchers concluded that 61 out of the 62 institutions held library guides or websites related to research impact tools and concepts, detailing highest frequency topics across both traditional and "new metrics" (Suiter and Moulaison 2015, 814). In 2023, Craft-Morgan conducted a scan of 50 select ARL member institutions to identify the presence of research impact metrics including: article, journal, author, identifiers, research profiles, responsible use of metrics, as well as information on bias or Diversity, Equity, Inclusion, and Justice (DEIJ) resources within research impact guides (Craft-Morgan 2023).[1] Craft-Morgan identified that of the research impact guides reviewed,

1. This research is ongoing and was obtained through an OCLC Works in Progress Webinar titled, "Why don't research impact LibGuides include bias-related resources" on July 25, 2023. Craft-Morgan's results and recorded presentation are now archived on the OCLC Research website (Craft-Morgan 2023).

> only 14% included information or discussion about bias or DEIJ resources… [while] over 90%… contained information about article, journal, or author metrics, identifiers, and researcher profiles… [and] nearly 50% had information about responsible use of metrics. (Craft-Morgan 2023, 25:50-26:22)

We intend to fill gaps in the literature by focusing on online instructional materials related to bibliometrics and research impact in CARL academic member institutions. With this subset of libraries, we will make distinct conclusions on competencies discussed in guides through keyword analysis, prevalence of additional instructional materials, specialist roles in Canadian academic libraries, and level of guide interaction with audience. Our intention is to investigate CARL bibliometrics and research impact guides to provide a distinct analysis of what bibliometrics competencies are being taught through publicly available resources at CARL institutions, and therefore draw conclusions of what bibliometric literacy looks like across Canadian academic institutions.

Methodology

Environmental scans are an increasingly utilized research tool to collect qualitative and quantitative data; they are used as methodologies in research as well as for internal evaluation and planning practices (Wilburn, Vanderpool, and Knight 2016). An environmental scan methodology is most successful when a clear plan, team, organization, and process is put into place before the scan begins (Wilburn, Vanderpool, and Knight 2016). Environmental scan methodology has been used widely across academia, in business, public health, and most relevant to this discussion, LIS (Wilburn, Vanderpool, and Knight 2016; Wheatley and Armstrong 2021). Within LIS, environmental scanning methodologies have seen an increase in popularity for their versatility of data collection and accessibility of results that allow the researcher to gain a greater understanding of the state of the field. This versatility is represented within a variety of recent studies in LIS, including a study by Charles (2021), which uses an informal environmental scan methodology to drive an evaluation of an information literacy program at Rutgers University, as well as Erickson and Shamchuk (2017), who utilized an environmental scan methodology to review post-secondary institutions' offerings of paraprofessional library education in Canada.

Specifically, use of research guides as a dataset for environmental scan methodology has been observed as a pattern in LIS, rooting back to 2002 when Hjørland suggested examination of librarian created subject guides as one approach to domain analysis. Hjørland notes that while this methodology could be used as a basis for other qualitative or user-based studies within domain analysis, evaluation of research guides is time consuming and becomes out of date quickly (2002). Use

of research guides for environmental scanning methodology is observed in a study by Wheatley and Hervieux (2019), who utilized this methodology to evaluate the presence of artificial intelligence within academic libraries in both the United States and Canada through university and university library website appraisal. Vaska and Vaska (2017) used environmental scan methodology to evaluate LibGuides at 17 Canadian post-secondary institutions to determine the prominence of grey literature within research supports, exploring the use of LibGuides as grey literature. Wheatley and Armstrong (2021) utilized an environmental scan methodology to evaluate 15 Canadian research-intensive institutions' LibGuides to determine the state of the field of entrepreneurial research guides. The methodology of Wheatley and Armstrong (2021) informed this environmental scan both in the use of research guides as a platform for analysis and in the use of related published core competencies to scope the project. We will utilize a similar methodology to Wheatley and Armstrong (2021) when comparing our own environmental scan data and the competencies for librarians, as were outlined by Cox et al. (2019). As detailed by this brief review of recent LIS literature, methods of environmental scanning provide useful insights into the state of the field and can be utilized for both broad association member review, such as CARL, ARL, or the U15 libraries, as well as internal institution review (Charles 2021; Wheatley and Armstrong 2021; Canadian Association of Research Libraries n.d.a; U15 Group of Canadian Research Libraries n.d.; Association of Research Libraries n.d.). For this reason, we chose an environmental scan as the instrument for this study's methodology, as it provides an overview of the current state of bibliometrics and research impact online instructional content at CARL academic member institutions through the point of view of the end user.

The dataset which was identified for this scan was the Canadian Association of Research Libraries (CARL). CARL is a group of 31-member libraries, 29 of which are academic libraries who serve Canadian research-intensive institutions, outlined in Appendix 1 (Canadian Association of Research Libraries n.d.a). As these libraries serve institutions with commitments to graduate study and research mandates, high frequencies of bibliometrics and research impact online instructional materials were expected and ultimately identified through this study (Canadian Association of Research Libraries n.d.b).

The data collection process took place between June to October of 2022. To ensure fluidity and standardization through the data collection process, one member of the research team implemented our workflow and recorded data for the environmental scan. This workflow included scanning the 29 CARL academic member institution's research guide searchable webpages, using the search terms "bibliometrics," "research impact," and "author identifier." When this page was unavailable, a general

internet search for "bibliometrics," "research impact," and "author identifier" at "[each CARL academic member institution's] library" was conducted. Once the guides had been identified, the data was collected and organized into a spreadsheet, as outlined below. Keywords were retrieved from the guides in a forward design methodology, meaning that the action of scanning drove the keywords recorded within this study, rather than use of a controlled vocabulary of expected terms that the authors were specifically looking for within the guides. These keywords were organized into five categories including: author metrics and identification, journal and publication metrics, tools and methodologies, companies and publishers, responsible and alternative metrics manifestos and movements, and a general category for keywords which did not clearly fit into another category.

Data Collection Spreadsheet:

1. CARL Member University
    a. Link to University Library Homepage
2. Data Collection Date
3. Link to LibGuide or Website
    a. Page Title
    b. Last Updated Date (if available through Springshare's LibGuide platform)
4. Keyword Categories
    a. Key Topics: General
    b. Key Topics: Author metrics and identification
    c. Key Topics: Journal and publication metrics
    d. Key Topics: Tools and methodologies
    e. Key Topics: Companies and publishers
    f. Key Topics: Responsible and alternative metrics manifestos and movements
5. Perceptions of Guide
    a. Class of Guide (1 or 2)
    b. Category of Guide (A, B, or C)
6. Types of Content (LibGuide, research website, or other)
7. Contacts listed for bibliometrics and research impact assistance
    a. Job title(s) of primary contact librarian(s)
8. Key observations note field.

These resulting data from this environmental scan for all CARL academic member institutions was initially analyzed between December of 2022 to May of 2023, and further refined in April of 2024. This environmental scan methodology provided significant qualitative and quantitative data from the perspective of the end user. This data allowed for large scale conclusions to be made about the state of the field of online bibliometrics and research impact instructional materials at CARL academic member institutions.

Results and Findings

Bibliometrics and Research Impact Guides at CARL Member Institutions

Between June to October of 2022, one research team member used our methodology to scan guides from the 29 academic member institutions which met the criteria of this environmental scan. The National Research Council Canada and Library and Archives Canada (CARL non-academic members) were removed from the dataset as they are not research libraries which serve their own university communities (the criteria of the scan). Therefore, 97% (28/29) of CARL academic member institutions held at least one guide which fit the criteria. Within these 28 institutions, 54% (15/28) of member institutions held multiple guides and the remaining 46% (13/28) of institutions held only one guide, resulting in a total of 56 guides reviewed within this methodology. Of the 56 guides, 77% (43/56) were recorded as LibGuides from the Springshare platform, recognizable from the 'Last updated,' or 'Log into LibApps' button on the research guide. The remaining 23% (13/56) institutions were held on alternative website platforms that were not immediately identifiable, and was therefore recorded as 'other,' as is outlined in figure 1.

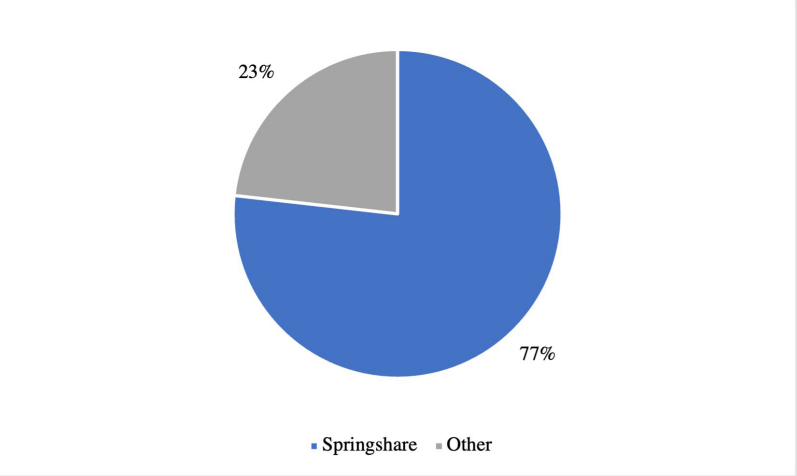

FIGURE 1 This figure shows the percentage use of research guide platforms at CARL Member Academic Institutions.

As the purpose of this study was to understand how CARL academic member institutions are teaching about bibliometrics and research impact at their institutions through online content, the researchers identified a distinction between levels of instructional content within guides. These two classes of guides can be described as informational (Class 1) or instructional (Class 2). A criterion was created to differentiate an informational guide from an instructional guide. An informational (Class 1) guide describes a guide that is simply a landing page or a site for information without significant contribution to the understanding of bibliometrics or research impact topics. An instructional (Class 2) guide describes a guide with supporting information, where the guide's intention is to instruct users on how to utilize tools, do manual calculations, or provide information to facilitate the understanding of bibliometrics and research impact tools. This analysis focused on identifying the purpose of the materials, but it should be noted that the instructional resources included on the guides are static and only occasionally contained interactive or multimedia learning components, with videos only identified within 13% (7/56) guides reviewed. 4% (2/56) of guides were classified as informational (Class 1) guides, while the majority of guides 96% (54/56) were classified as instructional (Class 2) guides. As most of the research guides scanned were identified as Class 2 instructional guides, conclusions can be drawn that the goal of the CARL academic member institution's bibliometrics and research impact openly available online content is to increase the understanding of bibliometrics and research impact within their academic communities.

Bibliometrics and Research Impact Guide Authors

To further understand the intention of the research guides analyzed through our environmental scan, a criterion was created to determine the level of interaction between the bibliometrics and research impact contact or personnel and the academic community. The three categories include class A, B, and C. Class A guide describes a guide with a single point of contact for assistance with research impact at the institution. For example, class A guides would identify that users contact XYZ Librarian at their institutional email for additional assistance with bibliometrics and research impact. Class B guide describes a guide with a general alias or link to a librarian (mostly liaison) directory for further contact of research impact at the institution. Class C guide describes a guide with no contact information included for research impact at the institution, as is directly outlined on the research guide.

As outlined in figure 2, 34% (19/56) of guides were classified as a class A guide, 36% (20/56) of guides were classified as a class B guide, and 30% (17/56) of guides were classified as a class C guide. This finding indicates that of the 34% (19/56) guides

scanned, there is at least one specific individual who would assist with bibliometrics and research impact inquires at that institution. While at the remaining 66% (37/56) of guides scanned suggest that while there is not one named individual at the institution to assist with bibliometrics and research impact inquires, through additional contact to the library, the end user would receive assistance with bibliometrics and research impact. It was however not clear whether class B and class C guides were indicating a robust team-based approach to these services, or if this indicates nascent services in bibliometrics and research impact at these CARL academic member institutions.

Of the 34% (19/56) of guides which were categorized as class A, the titles of listed guide authors varied within three groups. The most frequently listed job title for direct contacts included Scholarly Communications Librarians and similar titles, the second most prevalent job titles were Liaison or Subject Librarians, and the rarest job title of listed contacts were specialist roles, including a Digital Scholarship Librarian, and a Bibliometrics and Research Impact Librarian. This finding identifies that the librarians providing bibliometrics and research impact instruction at CARL academic member institutions through the pathways of asynchronous research guide creation hold a wide variety of job titles. Therefore, it is reasonable to assume that bibliometrics and research impact is a core competency for not just specialist roles, but also generalist roles, such as scholarly communications and liaison librarians.

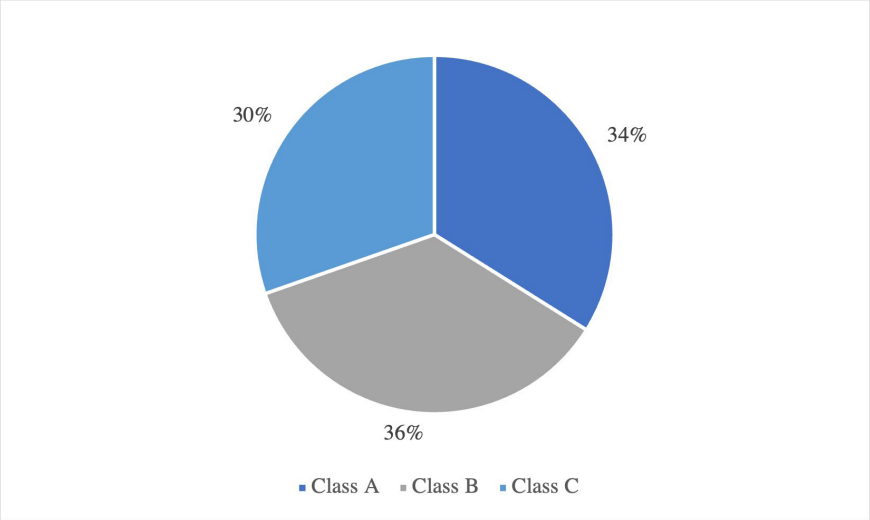

FIGURE 2 This figure shows the breakdown by percentage of guides with a named individual with direct responsibility for bibliometrics (Class A), a general email alias or link to librarian Directory (Class B), or no contact information provided (Class C).

Bibliometrics and Research Impact Guides at CARL Member Institutions Key Concepts

Within the 56 guides reviewed, there were a variety of key concepts discussed. These key concepts were examined through the collection of keywords from each of the 56 guides. These keywords were then organized within five main categories including: author metrics and identification, journal and publication metrics, tools and methodologies, companies and publishers, as well as responsible and alternative metrics manifestos and movements. To calculate the frequencies found in figure 3, the number of guides containing keywords within the five main categories were counted. If the guide held keywords in a category, it was accounted for; if the guide did not hold keywords for a category, it was not accounted for.

As outlined in figure 3, keywords related to the five categories of:

- Author metrics and identification were observed within 75% (42/56) of guides,
- Journal and publication metrics were observed within 66% (37/56) of guides,
- Tools and methodologies were observed within 96% (54/56) of guides,
- Companies and publishers were observed within 91% (51/56) guides,
- Responsible and alternative metrics manifestos and movements were observed within 38% (21/56) of guides.

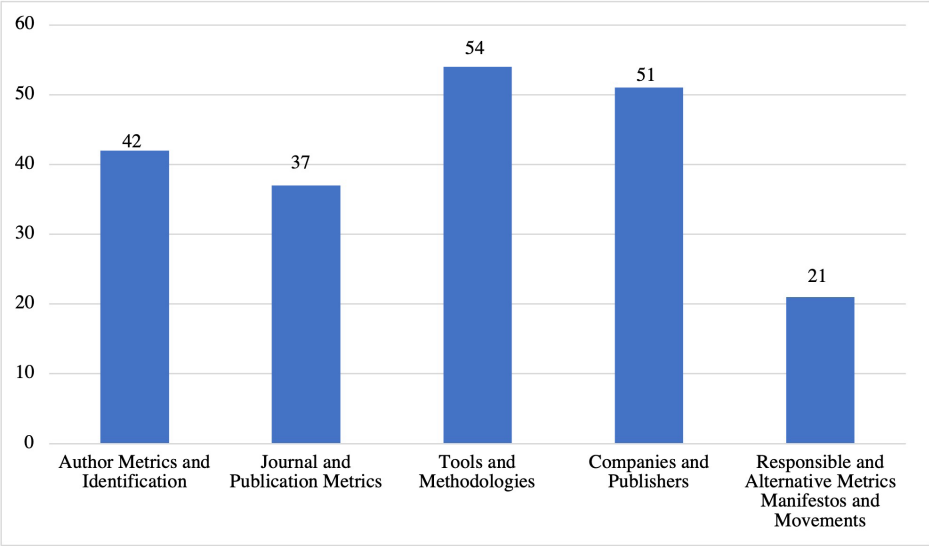

FIGURE 3 The five most frequent topics found within CARL academic member institutions research guides.

Within each category, the top five most prevalent keywords, along with their frequency of appearance within the 56 scanned guides have been identified and are displayed within tables 1, 2, 3, 4, and 5. Additionally, general or generic keywords that did not fit into any of the five main categories but were still considered important to

note as keywords relevant to bibliometrics and research impact were recorded. These general keywords are displayed in table 6.

To calculate frequencies of keyword presence within the guides, distinct keywords were totaled to identify how many cases each keyword, and its closely related variants, appeared within the guides scanned. To ensure accuracy of keyword appraisal, the keyword data was organized in a way that the keywords could only appear in one category, on one occasion. For example, during the initial data collection ORCID[2] was considered relevant within two keyword categories: tools and methodologies, and company and publishers. However, upon further inspection of the data, the decision was made to organize keywords into only one category, the category that was most relevant to the keyword. This aided in the disambiguation of the data and reduced misleading results caused by double counting keywords. In the case of ORCID, its most relevant category is tools and methodologies. The keywords included in tables 1 through 6 provide additional context for each category and its top five most frequently identified keywords.

Additionally, some keywords were recorded by both the main keyword and the variant. For example, ORCID was reported with many variants, including: ORCID (Open Researcher and Contribution ID), ORCID (Open Researcher and Contributor ID), ORCIDiD, ContributorID (ORCID), Open Researcher and Contributor ID (ORCID), Open Researcher Community ID (ORCID) and ORCID Author ID. Therefore, when final keyword organization occurred, the authors only accounted for one of these variants per category, per guide. The variant keywords included within the keyword counts have been recorded exactly as they appeared in the guides and are included within the descriptions of tables 1 through 6.

Once total keyword counts were completed, the top keywords were identified within each of the categories. Those five keywords were then divided by the total number of guides scanned to find a frequency and corresponding percentage of keyword presence across this environmental scan. The research team's decision to narrow in on the top five most prevalent keywords allowed for a focused evaluation on the most frequently discussed topics within each keyword category. However, this decision also reduced the amount of variation within each category, removing the representation of keywords present at lower frequencies within the guides. It is therefore important to identify that there were many other keywords, methodologies, and companies discussed within the online instructional materials of CARL academic member institutions identified at lower frequencies, which are all still relevant to the landscape of bibliometrics and research impact.

2. ORCID is a not-for-profit entity which provides authors with a unique author identification number, through their tool of an Open Researcher and Contributor ID (ORCID n.d.)

Keyword	Frequency of Keyword in Guides
h-index	34/56 (61%)
Author Profile	16/56 (29%)
Author Identifiers	15/56 (27%)
i10-index	12/56 (21%)
g-index	9/56 (16%)

TABLE 1 Frequency of top 5 keywords in the author metrics and identification category. The variants for the keywords which are also included in this table include: Hirch's h-index, Hirch's h-factor, author profiles, scholarly profiles, scholarly profile, researcher profile, researcher identifiers, unique author identifier, unique researcher identification number, visual author identifier, author ID, author IDs, i-10 index, i10 index, and Egghe's g-index.

Keyword	Frequency of Keyword in Guides
Journal Impact Factor	28/56 (50%)
Eigenfactor	20/56 (36%)
SCImago Journal & Country Rank	19/56 (34%)
CiteScore	14/56 (25%)
Source Normalized Impact per Paper	14/56 (25%)

TABLE 2 Frequency of top 5 keywords in the journal and publication metrics category. The variants for the keywords which are also included in this table include: Journal Impact Factors, Journal Impact Factor (IF), Impact Factors, Journal Impact Factor (JIF or IF), Eigenfactor.org, Eigenfactor metrics, Eigenfactor project, SCImago Journal Rank, SCImago Journal Rank (SJR), CiteScore metrics, and Source Normalized Impact per Paper (SNIP).

Keyword	Frequency of Keyword in Guides
ORCID	43/56 (77%)
ResearcherID	28/56 (50%)
Journal Citation Reports	24/56 (43%)
Impactstory	21/56 (38%)
Scopus Author ID	21/56 (38%)

TABLE 3 Frequency of top 5 keywords in the tools or methodologies category. Variants for the keywords which are also included in this table include: ORCID (Open Researcher and Contribution ID), ORCID (Open Researcher and Contributor ID), ORCIDiD, ContributorID (ORCID), Open Researcher and Contributor ID (ORCID), Open Researcher Community ID (ORCID), ORCID Author ID, Web of Science ResearcherID, Journal Citation Reports (JCR), Scopus Author Identifier, and ResearcherID (Scopus).

Keyword	Frequency of Keyword in Guides
Google Scholar	41/56 (73%)
Scopus	38/56 (68%)
Web of Science	37/56 (66%)
Mendeley	25/56 (45%)
Altmetric.com	23/56 (41%)

TABLE 4 Frequency of top 5 keywords in the companies and publishers category. The variants for the keywords which are also included in this table include: Altmetric, Altmetric It, Altmetric It!, Altmetric Explorer, Mendeley.com, and Mendeley Dataverse.

Keyword	Frequency of Keyword in Guides
Leiden Manifesto	11/56 (20%)
San Francisco Declaration on Research Assessment (DORA)	9/56 (16%)
NISO Alternative Assessment Metrics (Altmetrics) Initiative	7/56 (13%)
Altmetrics: A Manifesto	4/56 (7%)
Metric Tide	3/56 (5%)

TABLE 5 Frequency of top 5 keywords within the responsible and alternative metrics manifestos and movements category. The variants for the keywords include: Leiden Manifesto for Research Metrics, NISO Alternative Assessment Metrics Initiative, NISO Alternative Assessment Metrics Project, and NISO RP-25-2016 Outputs of the Alternative Assessment Metrics Project.

Keyword	Frequency of Keyword in Guides
Citation Count	25/56 (45%)
Impact	23/56 (41%)
Blog	21/56 (38%)
Social Media	20/56 (36%)
Citations	17/56 (30%)

TABLE 6 Frequency of top 5 keywords within the general category. Altmetrics and its variants, alternative metrics and alternative metrics (altmetrics) observed in 33/56 (59%) of guides has been removed as a top frequency keyword as it refers to a category of bibliometrics and research impact, rather than a specific keyword. The variants for the keywords which are also included in this table include: citation counts, blogging, and blog mentions.

The following discussion section draws conclusions as to which topics are discussed within the 56 CARL academic member institutions' research guides for

bibliometrics and research impact both generally and through keyword analysis. Specifically, the keywords outlined within table 1 through table 6 will be evaluated to draw conclusions on the similarities to related studies including, Cox et al. (2019), Nix and Smith (2019), Lewis, Sarli, and Suiter (2015), Suiter and Moulaison (2015), and Craft-Morgan (2023).

Discussion

The results of this environmental scan can be compared to similar studies which review the state of bibliometrics and research impact of other academic groups, including ARL, AAU, and QS World University Rankings (Lewis, Sarli, and Suiter 2015; Si et al. 2019; Suiter and Moulaison 2015; Craft-Morgan 2023). Findings from this environmental scan outlined that 28/29 (97%) of CARL academic member institutions hold guides on research impact. This high occurrence of online instructional material supports the findings from the 2015 SPEC Kit Report conducted on the ARL member institutions, which identified that 96% of the total respondents reported they provided "services… relat[ed] to scholarly output assessment" (Lewis, Sarli, and Suiter, 11). In 2019, Si et al. reported that 42% of libraries from their sample of the Top 100 of the QS World University Rankings provided research impact measurement services and training including "providing researchers with tools, methods, guidance and training on measuring research impact" (294). In 2015, Suiter and Moulaison investigated library webpages of the AAU for 18 key concepts, identifying that 61/62 (98%) of institutions held guides on research impact metrics (814). Through comparison of this environmental scan to these international articles, conclusions can be made that bibliometrics and research impact are key foci within academic librarianship both in Canada and the United States.

Categories of Key Concepts in Bibliometrics and Research Impact

This section investigates the key topics within bibliometrics, and research impact found within CARL academic member institution's guides to relevant studies which hold related lists of key competencies and topics (Cox et al. 2019; Nix and Smith 2019). The five categories identified within the analyzed guides in this environmental scan, as are outlined in figure 3, include author metrics and identification, journal and publication metrics, tools and methodologies, companies and publishers, and responsible and alternative metrics manifestos and movements. The first list of comparative key concepts used in this study is derived from Cox et al. (2019), who published a list of bibliometrics competencies that librarians may be required to perform within their jobs that range from entry to expert level. While these tasks are identified within the Cox et al. article as competencies for practicing librarians,

the list also outlines the general themes within bibliometrics and research impact work (2019). This list includes responsible use, group metrics, article metrics, journal metrics, and bibliometrics tools (Cox et al. 2019). These key categories are virtually mirrored within the Research Impact Core initiative session outline, titled "Research by the Numbers" by Nix and Smith (2019, 262). The session outline includes similar terms, including strengths and limitations of metrics, article level metrics, alternative metrics, journal metrics, h-index, and methods for enhancing impact (Nix and Smith 2019, 262). Both the key concepts suggested by the core competencies list by Cox et al. (2019), and "Research by the Numbers" session outline by Nix and Smith (2019, 262) exhibit strong similarities to the main categories identified within this environmental scan, as is outlined in figure 3. This finding identifies that concepts of author, journal, article, author disambiguation, bibliometrics tools or companies, alternative metrics, and responsible metrics are all key concepts within bibliometrics and research impact that should be found within online instructional content created by academic librarians to their academic communities (Cox et al. 2019; Nix and Smith 2019).

Frequencies of Key Concepts in Bibliometrics and Research Impact Guides

Within our findings, general conclusions can be drawn to determine which groups of key concepts are discussed at which frequencies across CARL academic member's research guides. As observed in figure 3, 96% (54/56) of guides analyzed within our environmental scan identified keywords related to tools and methodologies, 91% (51/56) of guides identified keywords related to companies and publishers, 75% (42/56) identified author metrics and identification, 66% (37/56) outlined publication and journal metrics, while only 38% (21/56) of guides identified responsible metrics within the institutional guides. Comparison between these frequencies can be made to the research conducted by Craft-Morgan in 2023, who investigated information included in 50 ARL institutional research guides on the topics of bibliometrics and research impact. Craft-Morgan reported that 98% of guides contained information on article, journal, or author metrics, 94% of guides contained information on identifier or researcher profiles, and information on responsible use of metrics was observed in 48% of the guides (2023 25:50). Comparing the general presence of information between Craft-Morgan's ongoing research and this environmental scan, conclusions could be drawn that general categories of article, author, journal, publication, author identification, and responsible use of metrics are all key concepts discussed in bibliometrics and research impact guides at both CARL and ARL member institutions (2023).

Conversations regarding responsible use of metrics have been increasing within recent years (Cabezas-Clavijo and Torres-Salinas 2021). Cox et al. (2019), identified that responsible use of metrics is a key core competency within research impact librarians' jobs, further forecasting that responsible use of metrics will be of "increasing importance in the next five years" (757). It is therefore notable that responsible metrics are discussed at a much lower rate than other, traditional concepts within bibliometrics and research impact guides at both CARL and ARL institutions (Craft-Morgan 2023). While responsible metrics are discussed within 48% of guides scanned by Craft-Morgan (2023), keywords related to responsible and alternative metrics manifestos and movements were only present in 38% of guides at CARL academic member institutions, as is outlined in figure 3. Possible explanations for the difference in frequencies between traditional and responsible use of metrics, could be that the intention of the guides scanned is to introduce users to key concepts within research impact and bibliometrics, and that a higher level of understanding would be required to address the responsible metrics movement. Vileno outlined in 2007 that "most librarians would say that their pathfinders are intended for students and other clients in the early stages of the research process" (442). While Coombs and Peters note that adherence to responsible metrics "requires significant increase in bibliometric expertise" (2017, 1).

A possible explanation for the lower frequency of responsible metrics in this study, when compared to Craft-Morgan's findings, is that the category of keywords in this study was specific to named manifestos and movements, rather than general information regarding responsible metrics (2023). In other categories of this study, keywords within the scope of alternative metrics were identified, including blog, social media, Impactstory, and Altmetric.com, in tables 6, 6, 3, and 4, respectively. These keywords could ultimatley be accounting for the responsible use of a "basket of measures" to evaluate impact (Byl et al. 2016, 15). Therefore, conclusions can be drawn that information on responsible metrics are still prominent within the guides at CARL academic member institutions, even if the specific responsible metrics movements and manifestos are not discussed at the same level as other traditional metrics keyword categories. A common conclusion between Craft-Morgan's study, and this environmental scan, is that responsible metrics are not being discussed within the majority of bibliometrics and research impact guides across North America (2023). Librarians must increase their instruction surrounding responsible use within library guides, as this is a primary pathway of instruction and essential mode of communication for bibliometrics and research impact within academia. Inclusion of these topics within library guides will ensure that academic communities understand how metrics are commonly misused, and how metrics can be used responsibly to accurately evaluate research impact.

Keyword Analysis

The following section compares tables 1 through 6 to draw conclusions as to the highest frequency keywords within the categories of author metrics and identification in table 1, journal and publication metrics in table 2, tools and methodologies in table 3, companies and publishers in table 4, responsible and alternative metrics manifestos and movements in table 5, and the general keywords in table 6.

Author Metrics and Identification

As observed within table 1, the results identify that the highest frequency of key concepts within the author metrics and identification was the h-index, found in 61% of guides. This is an expected outcome, as Suiter and Moulaison (2015) identified the h-index as the "most well-known metric for scholars" (815). Also outlined in table 1, the i10-index was observed within 21% of guides, while the g-index was observed within 16% of guides. Both the i10-index and the g-index are "generalizations of the h-index," as defined by Byl et al. (2016, 20), and therefore it is expected that these two variants, alongside the h-index, would be frequently identified within this environmental scan. The terms 'author profile' and 'author identifiers' were observed within 29% and 27% of guides, respectively. These are common concepts that were frequently used within the guides to indicate an author's citation or scholarly profile, and their associated author identification numbers, separate from the platforms which hold author profiles, such as ORCID, Impactstory, Google Scholar, Web of Science, or Scopus. While similarities can be observed between the study by Suiter and Moulaison (2015) and the keywords within this environmental scan, our study differs as it was created through a forward design environmental scan methodology. The action of scanning drove broad keyword results in this scan, rather than the design that Suiter and Moulaison utilized, where the researchers identified the keywords that they expected to find and utilized those keywords to search the AAU webpages (2015). Due to these differences in methodology, this environmental scan's results hold some general keywords, such as author profile and author identifiers, as well as more specific author level metrics, such as the h-index, g-index, and i10-index.

Journal and Publication Metrics

Journal and publication metrics keywords were observed within 66% of the guides scanned, as indicated in figure 3. Within the journal and publication metrics category, there were many different metrics identified to determine the impact of journals, specifically the Journal Impact Factor was identified at the highest frequency within 50% of guides, while the CiteScore was observed within 25% of guides. The CiteScore

is a journal metric which utilizes Scopus (Elsevier) data, while the Journal Impact Factor is a journal metric which utilizes Web of Science (Clarivate) data (Elsevier 2023a; Clarivate 2021). The Impact Factor, an included variant for the Journal Impact Factor as is outlined in table 2, was also identified at high rates within the Suiter and Moulaison study (2015). Both the Journal Impact Factor and the CiteScore were referred to in the "Research by the Numbers" session outline as journal level metrics, noting the strengths and limitations of each (Nix and Smith 2019, 262). While there has been recent criticism for Journal Impact Factors, as described by Bredahl in 2022, conclusions from this environmental scan outline that institutions in Canada continue to teach these concepts to their academic communities. In contrast, the other three keywords within this category are journal evaluation metrics that are alternatives to the Journal Impact Factor (Suiter and Moulaison 2015). These include the Eigenfactor, found at 36% frequency, SCImago Journal & Country Rank found at 34% frequency, and the Source Normalized Impact per Paper (SNIP) found at 25% frequency across the guides. Therefore, conclusions can be drawn that librarians at CARL academic member institutions are promoting both traditional journal metrics and "new metrics" (Suiter and Moulaison 2015, 814) to their academic communities.

Tools and Methodologies

As observed in table 3, all keywords from the tools and methodologies category were identified at over 38% frequency within the scanned guides. This conclusion may suggest that tools and methodologies of assessing impact are large areas of instruction at CARL member institutions, or that these five specific tools (Impactstory, Journal Citation Reports, ORCID, Researcher ID, and Scopus Author ID) are all popular within the field. 4/5 keywords from this section are specialized tools which assist in author disambiguation and understanding researcher impact. The highest frequency keyword in this category is ORCID, which is mentioned within 77% of guides. Impactstory, identified within 38% of guides is an author profile tool, which encompasses alternative metrics and other non-traditional bibliometric outputs in describing author impact (OurResearch n.d.). ResearcherID was identified within 50% of guides, while Scopus Author ID was identified within 38% of guides – both are author identification tools provided within the Web of Science (Clarivate) and Scopus (Elsevier) platforms, respectively (Clarivate 2023b; Elsevier 2023b). Distinct conclusions can be drawn from this data to determine that 4/5 highest frequency keywords within the tool and methodology section of this environmental scan include author identification tools. Therefore, author identification is of high importance to the bibliometrics and research impact landscape of CARL academic member institutions and their communities. The last keyword from this category, found within 43% of guides is Journal Citation Reports. Journal Citation Reports

is a tool within the Clarivate platform, which uses Web of Science data to provide information about journals, including the Journal Impact Factor, which was also found at high frequencies in the journal and publication metrics section of this environmental scan (Clarivate 2023a). 3/5 of the highest frequency keywords in the tools and methodologies category of this environmental scan are held within two large companies, Scopus Author ID is a Scopus (Elsevier) product, while Journal Citation Reports and Researcher ID are Web of Science (Clarivate) products (Elsevier 2023b; Clarivate 2023b; Clarivate 2023a). Elsevier and Clarivate are not only prominent within both the tools and methodologies section, and companies and publishers' section of this scan, but are also identified at high rates across related studies, including Lewis, Sarli and Suiter (2015) and Suiter and Moulaison (2015). Therefore, conclusions can be made that both Elsevier and Clarivate are large influencers within the scope of bibliometrics and research impact in both Canada and the United States.

Companies and Publishers

The frequencies of the keywords within the companies and publishers section of this environmental scan, as is observed in table 4, are quite high when compared to the other groups of keywords. The highest frequency within this section is Google Scholar which was observed within 73% of guides, while Scopus and Web of Science were observed within 68% and 66% of guides, respectively. Altmetric.com is mentioned within 41% of guides, allowing for conclusions to be drawn that the alternative metrics movement is prominent within academic libraries in Canada. Mendeley is also discussed within 45% of guides. This finding is significant to note, as no other reference management software met this frequency within the guides reviewed. These findings are reiterated by Suiter and Moulaison, who found high frequencies of mentions to Altmetric.com and ORCID within the AAU guides scanned (2015). Additionally, ORCID, Scopus, Web of Science, and Google Scholar are all mentioned within the "'Research by the Numbers' session outline" at the University of Michigan (Nix and Smith 2019). Further, Scopus, Web of Science, Google Scholar, and Altmetric.com were all reported at various frequencies by University Librarians at ARL institutions, as "scholarly output assessment software and resources that are used by library staff and/or are recommended to user groups" (Lewis, Sarli, and Suiter 2015, 23). Prominence of these major contributors to research impact is not surprising, in that they contribute significantly to the landscape of bibliometrics and research impact through a variety of types of metrics, as well as author disambiguation. As is outlined previously in this article, the top five frequencies of each keyword category have been identified to focus the results of this scan. It is critical to note that there are also many other contributing companies to the

bibliometrics and research impact landscape, which were present within the results of this scan, be it at lower frequencies. These companies and publishers varied from other reference management software to alternative metrics companies, various named publishers, and even large social media companies.

Alternative and Responsible Metrics Manifestos and Movements

Alternative and responsible metrics manifestos and movements were present at lower rates within the CARL academic member institutional guides, when compared to the other groups of keywords. The highest frequency keyword within this section was the Leiden Manifesto, identified within 20% of guides. Additionally, the San Francisco Declaration on Research Assessment (DORA) was identified within 16% of guides, and the Metric Tide was observed within 5% of the guides. These moderate frequencies are visualized in table 5 and identify that responsible use of metrics are being discussed at the CARL academic member institutions, as well, that specific documents are identified for future readings, including the Leiden Manifesto (Hicks et al. 2015), DORA (n.d.), and the Metric Tide (Wilsdon 2016b). The responsible use of metrics movement, namely the Leiden Manifesto, is also discussed in the "overview of metrics' strengths and limitations" section of the "Research by Numbers" session outline at the University of Michigan (Nix and Smith 2019, 262). This finding identifies both the presence of the responsible use of metrics in bibliometrics and research impact discussions, as well as the presence of follow up readings for the responsible use of metrics in instructional materials. In addition to the specific responsible metrics manifestos and movements, this section of keywords also addresses alternative metrics movements, such as NISO Alternative Assessment Metrics observed within 13% of guides, and Altmetrics: A Manifesto, identified within 7% of guides. Conclusions can be drawn that academic institutions across North America are referring to alternative forms of metrics, as well as best practice resources such as the Leiden Manifesto to encourage responsible use of metrics when measuring research impact.

General Keywords

The general keywords category was initially meant as a 'catch all' for those keywords which are not appropriately distinguished into a more specific category, such as blog, peer review, funding, or datasets. As observed within table 6, this was accurate for 3/5 keywords within this category, citation counts were observed in 45% of guides, citations were observed within 30% of guides, and impact was observed within 41% of guides. However, after analyzing the data to locate the top five keywords within this general category, 2/5 top keywords were within the scope of alternative

metrics. These keywords included: 'blog' observed within 38% of guides, and 'social media' observed in 36% of guides. While these two keywords are within the topics of alternative metrics, they are not specifically alternative metrics manifestos and movements, or companies and publishers, and therefore they do not fit within the other categories of this scan. Suiter and Moulaison (2015) identified altmetrics or alternative metrics as one of the expected terms for their environmental scan, locating mentions of altmetrics or alternative metrics in 80.3% of guides scanned (814). While the specific keywords within the scope of alternative metrics were identified within lower frequencies in our own environmental scan, they are spread across multiple categories. These categories include companies and publishers with Altmetric.com present within 41% of guides, tools and methodologies with Impactstory present within 38% of guides, responsible and alternative metrics' manifestos with Altmetrics: A Manifesto present within 7% of guides, and general keywords with blog and social media found within 38% and 36% of guides respectively. Conclusions can be made that alternative metrics and responsible metrics, or "newer metrics" as is described by Suiter and Moulaison (2015, 814), are taught within the online instructional content of North American academic libraries, in combination with traditional metrics.

Conclusions and Summary

This environmental scan has provided a snapshot of the current offerings of bibliometrics and research impact openly available online instructional materials at CARL academic member institutions. Overall, 97% (28/29) of CARL academic member institutions hold guides on this topic. Many of these guides (96%) are observed as instructional, identifying that they are more than classic "pathfinder[s]" or landing pages to information of how to access library resources (Vaska and Vaska 2017, 82). However, it is important to note that many of these online instructional materials were static in their content, with only 13% (7/56) guides containing multimedia content. 77% of the guides were recorded to be held on Springshare's LibGuide platform, concluding that LibGuides are utilized within a majority of the CARL academic member institutions to communicate content to users. Distinct authors of guides and their contact information are prominent within approximately one third of all guides as displayed in figure 2. When author's names were included in guides (Class A), their titles varied, with Scholarly Communication Librarians being the most frequently listed guide author title. This finding aligns with similar conclusions by Cox et al. (2019), and which outlines that job titles of practicing bibliometrics and research impact librarians vary greatly across institutions.

The key categories of bibliometrics discussed within research guides of this scan includes author metrics and author identification, tools and methodologies, journal and publication metrics, companies and publishers, responsible and alternative metrics manifestos and movements. The top major companies discussed within this environmental scan include Google Scholar, Scopus, and Web of Science, which supports the finding that these companies are major contributors to the state of bibliometrics and research impact within the Canadian context. The results of this environmental scan identify the top five most frequent keywords in each of the categories, outlining 30 keywords that are most frequently discussed within bibliometrics and research impact guides at CARL academic member institutions. While these 30 keywords were most prevalent, there were significant amounts of data collected which were not included within this focused results list that are also important to the landscape of bibliometrics and research impact. Best practices of guide creation would include both the large companies and top keywords that are present at highest frequencies within this scan, but also the variety of other tools that are available to assist with bibliometrics and research impact. Inclusion of various tools, keywords, emerging topics, and discussion of difficult to explain topics such as responsible metrics are critical and will contribute to the bibliometrics literacy of academic communities.

CARL member institutions are using research guides to educate their community about various key and emerging topics within the academic library, including bibliometrics and research impact. As it was the intention of this environmental scan to identify what openly available online content is available to end users, research guides or websites were the only platforms which were scanned for instructional content on bibliometrics or research impact. Possible other methodologies, and future directions of this research topic could include contacting key stakeholders at the CARL academic member institutions to understand more about their instruction and outreach services offered for bibliometrics and research impact. Another possible future direction of this research could be to study the topic of bibliometrics and research impact over time within the roles of academic librarianship to evaluate how bibliometrics and research impact are a continually evolving and growing field of librarianship. This insight would provide valuable research into the resourcing needs, future planning, and service sustainability for bibliometrics and research impact services within academic libraries. Additionally, although this research has been started by Craft-Morgan (2023), another possible direction for this research topic could be to evaluate bias and Equity, Diversity, Inclusion, and Accessibility concepts within bibliometrics and research impact guides at CARL academic member institutions. This study has begun to explore the current state of bibliometrics and research impact at CARL academic member institutions, however, we think that

there are many future research pathways that could build on the findings from this study. As was the primary driving force of this study, we hope that the results of this environmental scan will aid current and future librarians in updating and creating instructional content and research guides on bibliometrics and research impact at their own academic institutions.

ABOUT THE AUTHORS

Megan Palmer, BSc, MLIS (she/her), is now a Reference and Instruction Librarian at SUNY Oneonta and was formerly an MLIS co-op student at the University of Waterloo Library. In her current role she supports information literacy and research practices for students, staff and faculty at SUNY Oneonta in science and social science fields. Her research interests include information literacy, artificial intelligence, and peer-review of teaching in librarianship.

Laura Bredahl, MLIS (she/her), is the Bibliometrics and Research Impact Librarian at the University of Waterloo. Her work focuses on research intelligence and evaluation using analytical assessment of research impact and outputs within academia. She supports university leadership, faculties and departments and the broader community in research impact and bibliometrics analyses, services, use and governance.

Kari D. Weaver, MLIS, EdD (she/her), is the Learning, Teaching, and Instructional Design Librarian at the University of Waterloo. In this role, she oversees the development and assessment of online learning and builds teaching and learning partnerships across units and institutions. Her research interests include information literacy, co-teaching, digital accessibility, generative artificial intelligence, and academic integrity in the STEM disciplines.

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Appendix 1: CARL Academic Member Institutions

University of Alberta

University of British Columbia

University of Calgary

University of Manitoba

University of Regina

University of Saskatchewan

Simon Fraser University

University of Victoria

Carleton University

Brock University

University of Guelph

McMaster University

University of Ottawa

Queen's University

Toronto Metropolitan University

University of Toronto

University of Waterloo

Western University

University of Windsor

York University

Concordia University

Dalhousie University

University of New Brunswick

Memorial University

McGill University

Université de Montréal

Université de Québec Montréal

Université de Sherbrooke

Université Laval