

A Bibliometric Study of Research on Open Educational Resources and Higher Education

Assessing Trends and Scholarly Productivity in Library and Information Science

Rachel Chandler¹

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Abstract

Open Educational Resources (OER) play a key role in reducing the financial burden and increasing the accessibility of learning for students in higher education. OER can be considered an important field of research for academic librarians and supports the democratic mission of academic libraries. This study aimed to track the publication of scholarly literature about OER and higher education from 2002 to 2022 using a bibliometric research methodology. In addition, this research sought to assess the productivity of Library and Information Science (LIS) scholarship on this topic and investigate research trends, like open textbooks. Web of Science (WOS) was searched for publications and the search results were mapped to determine publication productivity, core authors, core journals, and research topics in the scholarly literature about OER and higher education. Research on OER has been steadily increasing since 2002, and this study indicates that research has increased significantly on the topic in the last six years. The data in this study support that most productivity in research on this topic is in the field of Education, but also found a presence of scholarship on the topic in the field of LIS.

Introduction

The Open Educational Resources (OER) movement seeks to encourage the development and dissemination of openly accessible resources and is a key aspect of increasing accessibility and promoting innovation in higher education (Pitt et al., 2020; UNESCO, 2002). Research and

¹ *Science and Data Visualization Librarian, Georgia State University, Atlanta, Georgia, USA*

E-mail: rhandler@gsu.edu

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implementation of Open Educational Practices (OEP) at universities and colleges has been demonstrated to facilitate a more equitable environment for students of different socioeconomic backgrounds (Martin et al., 2017). Availability and accessibility of OER texts for students is critical when the Education Data Initiative reports that the average full-time, in-state undergraduate student at a four-year public university pays over a thousand dollars for books and supplies in one academic year, and 11% of students report skipping meals to afford course materials and books (Hanson 2022, para 2). Open textbooks, a common type of OER, have been demonstrated to lessen students' high costs while still being equal in quality to commercial textbooks and eliciting comparable academic performance (Jhangiani, 2018). The OER movement naturally aligns with the democratic mission of academic libraries, and an academic library is one way to distribute OER texts to students. As a movement that increases access and promotes learning, OER are an important research topic for academic librarians.

As the OER movement continues to develop, it is important to observe the patterns and trends in research about OER and higher education. Hopefully, this encourages the implementation of more OER programs and the development of more OER materials. This study employed a bibliometric analysis method to investigate scholarly research about OER and higher education published from 2002 to 2022 and to measure how productive research is on this topic. This research determined how many scholarly articles on this topic were published yearly, the core journals, the core authors, the most popular article keywords, and the most highly cited publications about OER and higher education. In higher education, academic librarians can serve as strong advocates for OER programs and make OER texts accessible to students via an institution's library. To investigate scholarship about OER and higher education in the field of Library and Information Science (LIS), this study identified the productivity of LIS-specific journals on this topic, the presence of article keywords about libraries, and the occupations of the core authors to determine if any were librarians. A previous study by Mishra et al. (2022) found that open textbooks are decreasing in popularity as an OER research topic. This could be problematic because other popular research topics, like open courseware, do not address or negate the issue of high textbook costs for students. This research observed the productivity of scholarship on the subtopic of open textbooks in OER research using article keywords. This specific analysis of subtopics was useful to assess what topics have been addressed in the literature and where further research is needed to increase the availability of open textbooks and other OER.

Literature Review

The term "Open Educational Resources" (OER) was created during UNESCO's Forum on the Impact of Open Courseware for Higher Education in Developing Countries in Paris, France (UNESCO, 2002). During the forum, OER was defined as "the open provision of educational resources, enabled by information and communication technologies, for consultation, use, and adaptation by a community of users for noncommercial purposes" (UNESCO, 2002, p. 24). The definition of OER now includes more resources like Massive Open Online Courses (MOOCs), public domain materials, and materials under Creative Commons licenses (Wiley et al., 2014). The rate of scholarly publication about OER has been steadily increasing since the UNESCO Forum in 2002, with a sharp increase in pace starting in 2012 (Tlili et al. 2021; Zancanaro et al. 2015).

Scholars have demonstrated that research on OER is focused on higher education (Mishra et al., 2022; Tlili et al., 2021; Zancanaro et al., 2015). Tlili et al. (2021) attribute this to the Massachusetts Institute of Technology (MIT) OpenCourseWare initiative, one of the first to provide high-quality open educational resources. McGowan (2019) observes that faculty support mechanisms and initiatives for OER development are becoming more sustainable at many universities and colleges. Though research into OER has been steadily increasing and is considered a promising field of research, OER initiatives often face drawbacks and challenges. Mishra et al. (2022) consider the language, lack of awareness of potential learners, lack of funding, and lack of infrastructure as limitations on globally implementing OER and OER initiatives, especially in underdeveloped countries. Despite the trend in research and the creation of OER, there is still a struggle to instill OER as permanently-funded resources at academic institutions (McGowan, 2019).

Libraries and OER Initiatives

The mission of the OER movement overlaps with the mission and function of academic libraries to serve students and faculty (Davis et al., 2016; Goodsett et al., 2016; Kimball et al., 2022). Though Goodsett et al. (2016) noted that the university library is the natural leader of OER initiatives, McGowan (2019) found that institutional teaching and learning centers often evenly share sponsorship of OER initiatives. Specifically, McGowan (2019) found that almost half of their sample of OER initiatives were sponsored by the institution's library and the rest by the institutional teaching centers. Sponsorship of OER initiatives by teaching centers is consistent with services they already offer through training to help faculty and teachers acquire OEP competencies and utilize OER (Tlili et al., 2021). Research has demonstrated that allocating part of the library budget, promoting OER with library resources, and providing training via librarians are good practices for open education (McGowan, 2019).

Academic librarians are ideally suited to helping faculty overcome barriers to discovering, evaluating, and utilizing OER (Kimball et al., 2022; Smith and Lee, 2017). Smith and Lee (2017) determined the roles of academic librarians in the OER movement as advocacy and promotion, providing strategies to evaluate the quality of OER, maintaining subject-based guides for OER resources, providing access to OER via institutional repositories, enhancing access to OER with metadata and indexing, managing intellectual property rights and open licensing of OER, and facilitating and curating OER collections. Two of the most common strategies academic libraries have for facilitating OER initiatives are hiring a dedicated OER librarian or implementing OER with subject librarians' expertise and their established faculty relationships (Kimball et al. 2022; Smith and Lee 2017). Though Kimball et al. (2022) found success with their subject-librarian-based OER program, Smith and Lee (2017) found that OER initiatives often add too many additional responsibilities to already heavy workloads. Smith and Lee (2017) suggested that forming "communities of practice" among regional academic librarians can provide a sustainable way to support open education and the advocacy of OER.

Open Textbooks

The OER movement seeks to ensure that knowledge is freely accessible and can be reused (Tlili et al., 2021). OER can significantly reduce college students' financial burdens (Clinton, 2018; Fischer et al., 2015; Kimball et al., 2022). One of the most significant financial burdens post-secondary students face is the high cost of textbooks, which can approach or even surpass the cost of tuition (Fischer et al., 2015). The price of textbooks and other academic costs are barriers that disproportionately affect students from lower socioeconomic backgrounds (Fischer et al., 2015; Jhangiani, 2018). High textbook costs are a driving factor in developing open or OER alternative textbooks to increase educational access for all students (Clinton, 2018; Kimball et al., 2022). As defined by OpenStax, a nonprofit OER initiative, open textbooks are those that are publicly available, free to access, and free from copyright restrictions (Swift, 2022). Though the price of renting or purchasing electronic textbooks is usually less than the price of purchasing print textbooks, open textbooks are often the least prohibitive and expensive option for students (Fischer et al., 2015). Fischer et al. (2015) found that students whose faculty assigned OER saved a significant amount of money compared to students whose faculty assigned commercial materials, with the same learning outcomes. Even further, students in courses using open textbooks were significantly more likely to enroll in more credits the following semester. Clinton (2018) had concurrent findings that open textbooks saved significant costs for students without negatively influencing students' perception of quality, learning outcomes, or user accessibility.

Kimball et al. (2022) determined that the primary responsibility of the OER librarian was to discover and promote open textbooks.. Facilitating access to open textbooks and hosting open textbooks in institutional repositories is aligned with the academic libraries' mission. This is supported by Thomas et al. (2021)'s user accessibility case study on digital open textbooks in which the authors found that the institutional repository was the student's preferred access point for open textbooks. However, McGowan (2019) found that most institutional awards or sponsorships did not favor open textbooks as library resources. They attributed this to the long-standing use of library course reserves and a lack of foresight from institutions to consider OER development as a financial investment. Some academic libraries have partnered with university presses to encourage investment in open textbooks and promote scholarly output (Thomas et al., 2021; Waller et al., 2017). Collaboration can give the university greater ownership over the content of open textbooks content and provide more opportunities for user experience testing to improve open textbooks (Thomas et al., 2021; Waller et al., 2017).

Bibliometric Research Literature Review

This study builds on the research methodology of three previous studies. Mishra et al. (2022) used bibliometric methods to survey recent developments in OER research, specifically looking at five subtopics of OER: "open textbook, open online course, open courseware, open-source software related to open education, and open social learning" (p. 1). Mishra et al. used the Scopus database to gather open data and map research development, journals, subject categories, authors, and research productivity by country. They found that the rate of publications about OER increased dramatically starting in 2012, with 2,474 scholarly articles published in their 18-year timeframe. Most interesting to this study, the

authors found that of their sub-themes of OER research, open textbooks are declining in popularity as a research topic.

Zancanaro et al. (2015) also used a bibliometric analysis to map publications about OER starting from 2002. The authors used the Web of Science Core Collection (WOS Core Collection) database, the OER Knowledge Cloud, and Scopus to gather data, but only for an 11-year period. The authors' results reflected a similar surge in publications about OER around 2012-2013, with a total of 544 publications that also included book chapters, conference proceedings, and reports. Notably, Zancanaro et al. did not limit the language of publications to English. From their bibliometric mapping, the authors found the main subtopics of global OER research to be theoretical discussion, quality, barriers to use, open education, incentive policies, surveys, technology, type, sustainability, production, and open licenses. Most importantly, they found that in 2015 when the study was completed, open textbooks were not one of the significant research subtopics of OER, simply a subcategory of the "type" research topic. By the time Mishra et al. (2022) conducted their study, open textbooks were an established research topic of OER research.

Tlili et al. (2021) also used both the WOS Core Collection and Scopus databases to gather data for a bibliometric mapping analysis, but instead of focusing on OER, their search keywords were "open educational practice" and OEP. The authors based their methodology on Zancanaro et al. (2015); they also did not limit the language of publications to English. After narrowing their search results by eliminating duplicate articles and filtering according to their inclusion criteria, they found 156 scholarly publications published within a 10-year period from 2000 to 2020 to analyze. Similarly, to Mishra et al. (2022), Tlili et al. used only peer-reviewed scholarly publications for analysis, excluding book chapters and conference proceedings. The authors found that OEP was first published as a research topic in 2007 and that the publication rate on the topic has been steadily increasing. The authors also found that most studies on the topic were qualitative and called for more quantitative studies of OEP initiatives.

Previous research established that the principles of the OER movement and academic libraries are aligned, and that OER can be successfully implemented on college campuses via the libraries and dedicated OER librarians or subject librarians. Because textbooks are a significant part of the academic cost of post-secondary education, open textbooks are crucial to reducing the financial burden of post-secondary students. Though Mishra et al. (2022) found that open textbooks are decreasing in popularity as an OER research topic, the issue of high textbook costs is not abated. Our study is similar to the previously discussed bibliometric studies in that it maps scholarly publications about OER and identifies core authors and journals, but it differs because it focuses on identifying the research about OER in higher education and in the field of Library and Information Science (LIS). Literature about OER and open textbooks is valuable to gather and share to support academic LIS professionals to provide access to open textbooks to students or host OER initiatives in their libraries. Analysis of the gathered literature can reveal where more research is needed on OER materials such as quality control, efficacy, and innovation, areas suggested by Fischer et al. (2015) and McGowan (2019).

Methods

This research employed a bibliometric analysis methodology to discover core journals, core authors, and frequent keywords of scholarly articles about OER and higher education. The data was collected from the WOS Core Collection database because it is one of the premier citation databases for scholarly publications, containing records for high-impact journals and conference proceedings with coverage back to 1900 (Zancanaro et al., 2015; Huang et al., 2022). In addition, the WOS Core Collection is used frequently for bibliometric analysis because it has high-quality indexing of peer-reviewed articles and is publisher-independent. The extensive coverage of the scholarly literature, citation reporting, and reference tracing are all ideal for bibliometric mapping (Huang et al., 2022). The methodology used in this research builds on the bibliometric methodology used by Zancanaro et al. (2015) and Tlili et al. (2021), both of which used the Web of Science (WOS) to conduct searches. WOS is also one of the preferred databases for Bibliometrix, the bibliometric mapping software used by Mishra et al. (2022) and used in this study (Aria and Cuccurullo, 2017). This research did not utilize the Scopus database, unlike the previously cited studies, because the host institution where this research was conducted did not have access to Scopus.

A search strategy was crafted based on the search term methodology used by Mishra et al. (2022) and Huang et al. (2022) but with search terms explicitly tailored to OER and higher education. It used a combination of keyword terms to find publications related to OER and higher education. The string of search terms was searched in the Topic field (symbol TS), which searches in the title, abstract, author keywords, and KeywordPlus fields for the search terms. WOS does not utilize controlled vocabulary or subject terms but has KeyWordPlus keywords which are index terms automatically generated from the titles of cited articles. The TS field terms were combined with a search string for the Document Type field (symbol DT) for Article, Review, and Proceedings Papers, which excludes the document types that are not scholarly papers like Book Reviews. Combining those search strings provided the following, which was copied and pasted into the search query box of the Advanced Search function:

((TS=(("open education" OR "open educational resources" OR "Open Pedagogy" OR "open textbook" OR "open access textbook"))) AND TS=((academic OR college OR universit OR "higher education" OR "post-secondary education" OR "tertiary education" OR "graduate school")) AND DT=(Article OR Proceedings Paper OR Review))*

The "Publication Date" field was set to "Custom." The start date was limited to the year 2002 when the term "open educational resources" was coined (UNESCO, 2002). The ending date was limited to 2022 because it is the most current full year to date. The following search string for publication was entered into the Advanced Search option below the Query Box:

Publication Year > Custom (2002-01-01 to 2022-12-31)

For data analysis, this research used the Bibliometrix R package, an open-source data analysis program designed for bibliometric data visualization and mapping (Aria and Cuccurullo, 2017). Bibliometrix is one of the most popular software for visualizing information from author keywords (Mishra et al., 2022). Once the sample was imported into Bibliometrix the data were filtered. The

records exported from WOS included Early Access articles released in 2022 but published in 2023. The Bibliometrix Publication Date filter was set from 2002-2022 to exclude these articles. After the data were filtered, they were analyzed for core authors, core journals, an increase or decrease in the literature on the topic, and keyword frequencies. The sample of journals was analyzed to find LIS-specific titles and to find LIS-specific keywords, then this data was used to assess the titles' frequency and impact. The core authors' occupations were determined with WOS records and ORCID iDs, if applicable, including if any core authors were librarians. The results were displayed in tables and figures created using Bibliometrix or Excel.

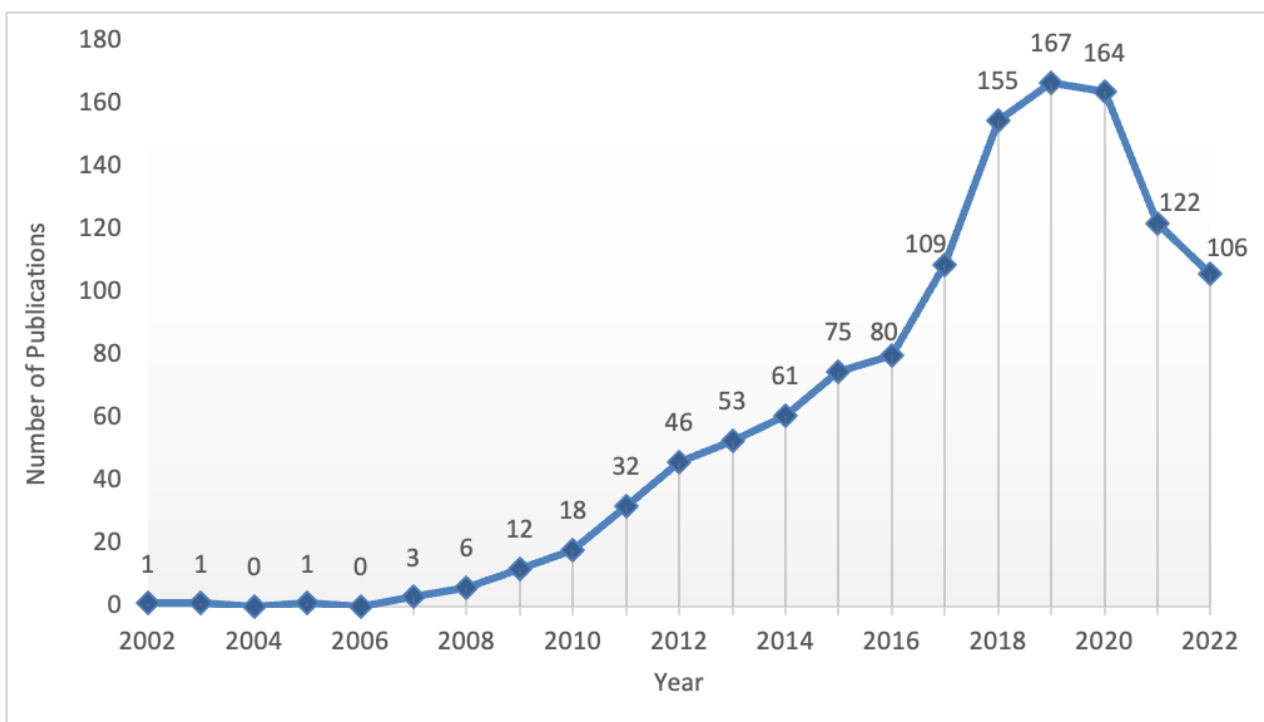
Results

Productivity of Research about OER and Higher Education from 2002 to 2022

This methodology resulted in 1,212 returns for full-text articles published from 2002 to 2022. The range of articles published on OER and higher education each year from 2002 to 2022 was 0 to 167 (see Figure 1). The lowest number of articles published in a given year was in 2004 and 2007 when no articles on the topic were published. The most articles published in a given year was in 2019 when 167 articles on the topic were published. Figure 1 shows the change in publication over time and demonstrates a steady increase in the number of articles published per year, with a peak from 2018-2020 and a slight decrease in the last two years in 2021 and 2022.

Figure 1

Annual Production of Scholarly Articles about OER and Higher Education



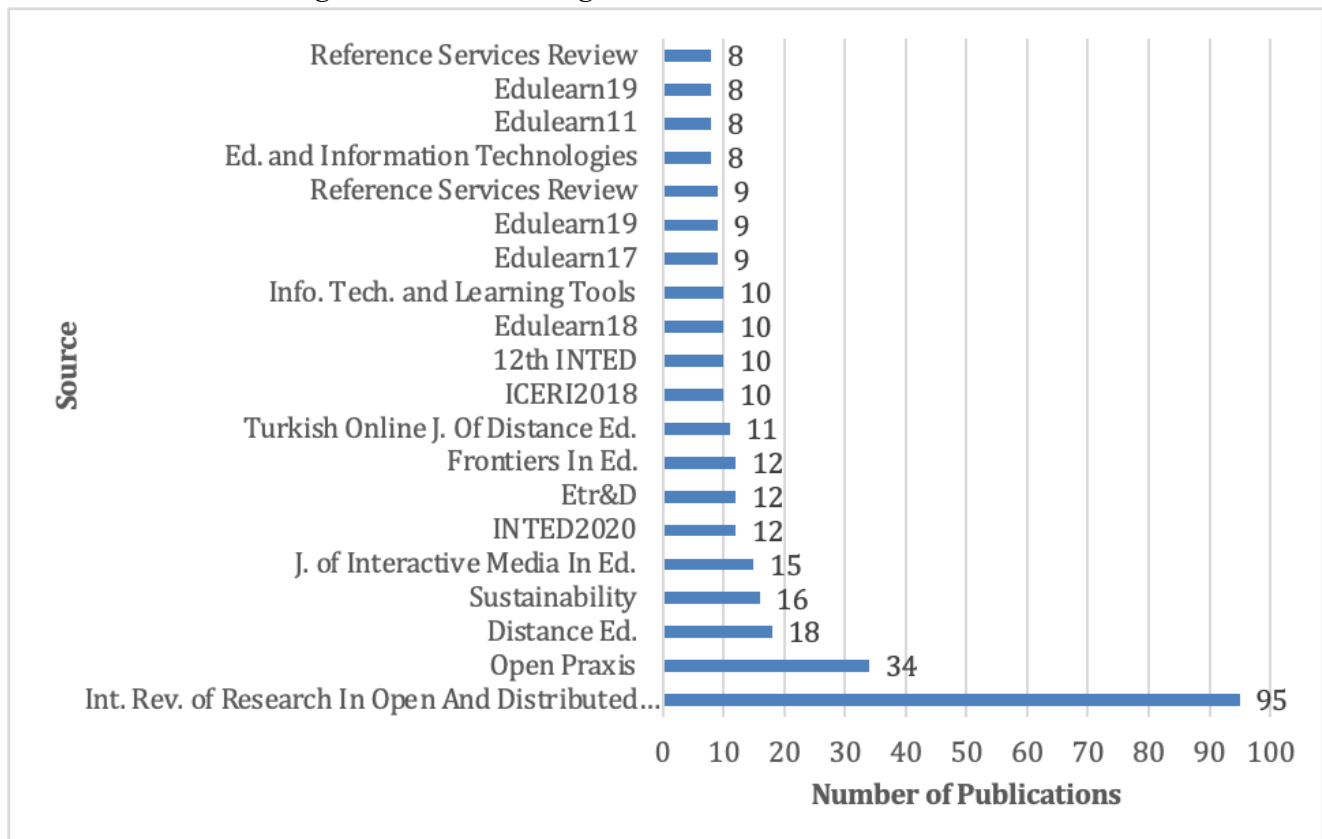
Note: The amount of scholarly publications about OER published per year from 2002 to 2022, n=1212 total publications.

The annual growth rate of publications was 26.26%. The mean number of articles published per year was 57.7, which can be rounded up to an average of 58 articles per year over 20 years. The mode number of articles was 1, the number of publications per year that frequently occurred in the first four years after the term OER was coined in 2002. Starting in 2014, the number of articles published per year was above the average, or more than 58 articles per year. The median number of articles published per year was 46 in 2012. 75% of articles on the topic were published in the last 6 years, from 2017-2022.

Core Journals and Core Authors of Publications about OER and Higher Education from 2002 to 2022

The core journals with the most publications on this topic were the *International Review of Research in Open and Distributed Learning (IRRODL)*, *Open Praxis*, *Distance Education*, *Sustainability*, *Journal of Interactive Media in Education*, *14th International Technology Education and Development Conference (INTED2020)*, *Educational Technology Research and Development (ETR&D)*, *Frontiers in Education*, *Turkish Online Journal of Distance Education*, and *11th International Conference of Education Research and Innovation (ICERI2018)* (See Figure 2).

Figure 2
Core Journals Publishing about OER and Higher Education



Note: The top twenty of 612 sources with the highest number of documents published on OER and higher education from 2002 to 2022, n=1212 total publications.

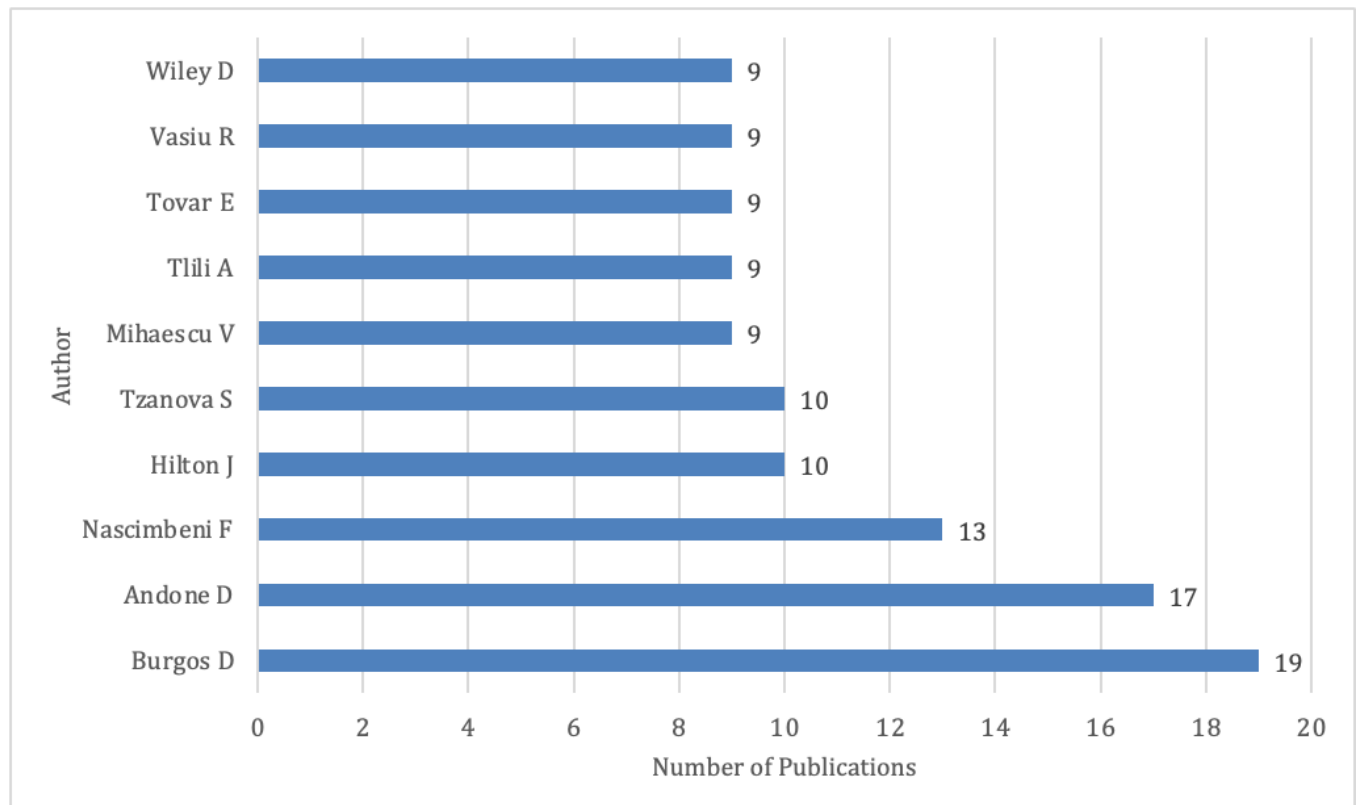
The *International Review of Research in Open and Distributed Learning* was the most prolific in publishing on this topic, with 95 (7.8%) of the total publications. This was followed by the journals *Open Praxis* which published 34 (2.8%) of the total publications, *Distance Education* which published 18 (1.5%) of the total publications, *Sustainability* which published 16 (1.3%) of the total publications, and the *Journal of Interactive Media in Education* which published 15 (1.2%) of the total publications. The *INTED2020*, *ETR&D*, and *Frontiers in Education* each published 12 (1%) of the total publications. The *Turkish Online Journal of Distance Education* published 11 (0.9%) of the total publications, and *ICERI2018* published 10 (0.8%) of the total publications.

A total of 612 different journals, including conference proceedings, published articles on this topic from 2002 to 2022. The distribution of publication of articles mostly adheres to Bradford's Law, that most research results on a given subject are published in a small number of journals, with 34 journals representing the top 33% of articles published on the topic. Though 34 is more than a few core journals, the following 33% of articles published on the topic come from 180 journals, and then the last 33% from 398 journals, showing exponentially diminishing returns as exemplified by Bradford's Law. Of the 612 journals that published articles on this topic from 2002 to 2022, there were 18 Library and Information Science (LIS) journals that published 41 of the total publications. Of the journals that published on this topic, LIS journals represent 2.9% of the total journals. Of the publications on this topic, LIS journals had 3.2% of the total published articles. No LIS journals were in part of the core journals identified in this study (see Appendix A: Figure 1).

Of the 1,212 articles published on this topic from 2002 to 2022, there were 2,824 authors. The most prolific author was D. Burgos, a Professor in the field of Education and Computer Science, with 19 publications (1.6%). D. Andone, a Professor and Director in the field of Education, authored 17 publications (1.4%). F. Nascimbeni, an Assistant Professor in the field of Technology and Education, authored 13 publications (1.1%). J. Hilton, a Professor in the field of Religion and Education, authored 10 publications (0.8%). S. Tzanova, a Professor in the field of Engineering and Education, authored 10 publications (0.8%). V. Mihaescu, a Professor in the field of Education and Computer Science, authored nine publications (0.7%). A. Tlili, an Assistant Professor in the field of Education and Computer Science, authored nine publications (0.7%). E. Tovar, a Professor in the field of Education and Computer Science, authored nine publications (0.7%). R. VasIU, a Professor and Director in the field of Education and Computer Science, authored nine publications (0.7%). D. Wiley, a Chief Academic Officer and Professor in the field of Education, authored nine publications (0.7%) (see Figure 3).

Figure 3

Authors with the Highest Number of Publications about OER and Higher Education



Notes: The top 20 of 2,824 authors that published the most on this topic and the number of publications, n=1212 total publications.

Of the top 10 authors, all are currently or formerly Professors and all are working in the field of Education or Computer Science. Those that are working in the field of Computer Science are affiliated with Engineering or Information Technology Departments. Of the 2,824 authors, 2,417 authors only published one article on this topic in the allotted time period. This number of authors publishing only one article supports the principle of Lotka's Law: that most authors only publish once on a given subject. In this sample, 85.6% of authors only published once on this topic from 2002 to 2022. As far as this research could ascertain, none of the core authors are or were librarians (see Appendix A: Table 1).

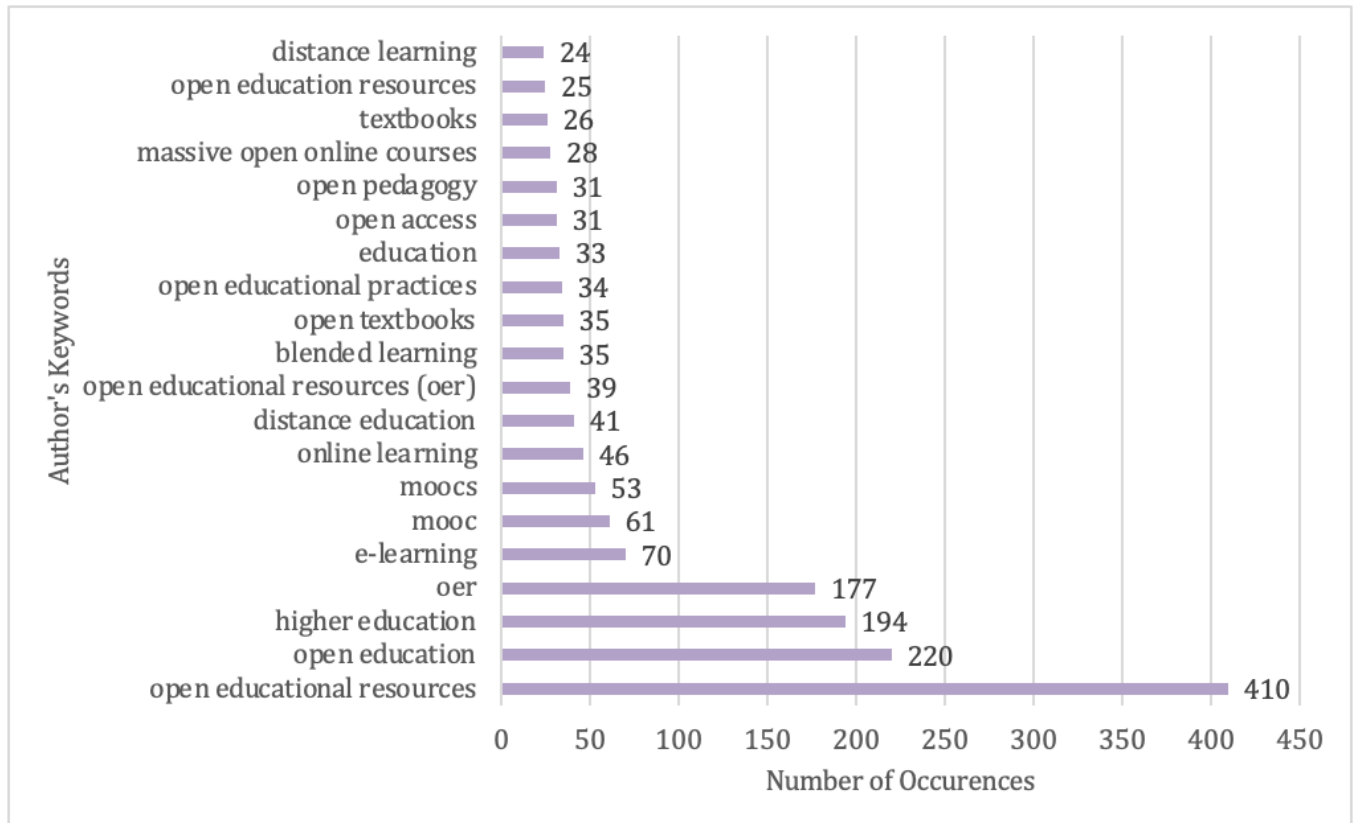
Keywords and Topics of Research in Publications about OER and Higher Education from 2002 to 2022

The WOS Core Collection indexes articles with Author's keywords and KeywordPlus keywords. Both types of keywords were analyzed for the sample. The articles collected in this sample have 2,807 different Author's keywords. The top 20 most frequent Author's keywords are *open educational resources, open education, higher education, oer, e-learning, mooc, moocs, online learning, distance education, open educational resources (oer), blended learning, open textbooks, open educational*

practices, education, open access, open pedagogy, massive open online courses, textbooks, open educational resources, and distance learning (see Figure 4).

Figure 4

Most Frequent Author's Keywords



Note: The top twenty most frequently used keywords and usage, $n=2807$ total Author's keywords

The articles collected in this sample are indexed under 547 different KeywordPlus keywords. The top 20 most frequent KeywordPlus keywords of articles on this topic were *adoption, oer, education, students, university, impact, perceptions, quality, higher-education, open educational resources, resources, technology, design, performance, outcomes, student, teachers, model, knowledge, and moocs* (see Appendix B: Figure 1).

This study also observed the productivity of research on this topic related to open textbooks. There were 33 Author's keywords related to open textbooks used 110 times, making up 1.2% of the total Author's keywords and 1.9% of the total Author's keyword usage. The most frequently used Author's keyword related to open textbooks was *open textbooks* which was used 35 times, and was number 14 in the top 20 most frequent Author's keywords for the sample (see Appendix B: Figure 2). There were 6 KeywordPlus keywords related to open textbooks used 25 times, making up 1.1% of the KeywordPlus Keywords and 1.8% of total KeywordPlus keyword usage (see Appendix B: Figure 3).

This study observed the productivity of research on this topic in the field of library and information science. There were 28 Author's keywords related to libraries or librarianship that were

used 61 times, making up only 1% of the total keywords and equalling about 1% of the total Author's keyword usage. The most frequently used Author's keyword related to libraries was *academic libraries* which was used 19 times (see Appendix B: Figure 4). There were six KeywordPlus keywords related to libraries or librarianship used nine times, making up 1% of the KeywordPlus keywords and 0.7% of the total usage of KeywordPlus keywords. The most frequently used KeywordPlus keyword related to libraries was *library* which was used three times (see Appendix B: Figure 5). WOS attaches at least one subject category to each record. In an analysis of the most frequently used WOS subject categories attached to the articles in this sample, the category of *Information Science and Library Science* was the 4th most frequent subject category for articles. The *Information Science and Library Science* subject category was used 102 times, making up 5.7% of total usage (see Appendix B: Figure 6).

Most Highly Cited Articles about OER and Higher Education from 2002 to 2022

The most highly cited scholarly article about this topic published between 2002 and 2022 was "Shift to digital perspectives on Hilton (2016) from the perspective of practice" by Hodges (2021) which was cited 278 times. The most highly cited article reflects on the second most highly cited article, "Open educational resources and college textbook choices: a review of research on efficacy and perceptions" by Hilton (2016). Hilton (2016) was cited 176 times. Both highly cited articles were published in the journal *Educational Technology Research and Development*. Of the top 20 most highly cited articles about this topic, five articles have keywords related to open textbooks. The keywords are Author's keywords and include *textbooks*, *open textbooks*, and *electronic textbooks*. Of both the Author's keywords and the KeywordPlus keywords for the top 20 articles, none of them are keywords related to libraries. Of the journals the top 20 most highly cited articles are published in, none are explicitly Library and Information Science journals. The top 20 articles are all categorized in the *Education and Educational Research* WOS subject category except one. Two of the articles have an additional category for *Computer Science*.

Discussion

The data gathered in this study offer insight into scholarly literature published about OER and higher education. This study was limited to articles collected from the WOS Core Collection database with access provided by the University of Southern Mississippi. The articles collected were limited to studies published in academic journals from 2002-2022. It was assumed that WOS has properly indexed articles so articles relevant to the topic could be found and that the keywords and advanced search option retrieved the most accurate and pertinent results. This study examined a total of 1,212 articles about OER and higher education published by 2,824 authors in 612 journals. The data indicates an increase in publications about this topic over time which is congruent with the findings of Mishra et al. (2022) and Zancanaro et al. (2015) that research on this topic is productive. Although there was a slight decrease in the number of publications per year in the last three years, which could be attributed to the COVID-19 pandemic, this research found that 75% of articles on this topic were published in the last six years and that the rate of publications per year has been above the average since 2014, which is similar to findings by Mishra et al. and Zancanaro et al. that there was a rate of increase around 2012-2013. The data

gathered in this study, and in Mishra et al. and Zancanaro et al., indicate that OER are an enduring and vital area of research.

The core journals that published on OER and higher education were *International Review of Research in Open and Distributed Learning (IRRODL)*, *Open Praxis*, *Distance Education*, *Sustainability*, *Journal of Interactive Media in Education*, *14th International Technology Education and Development Conference (INTED2020)*, *Educational Technology Research and Development (ETR&D)*, *Frontiers in Education*, *Turkish Online Journal of Distance Education*, and *11th International Conference of Education Research and Innovation (ICERI2018)*. *IRRODL* was the most prolific journal, with 95 total publications, and was the journal in which seven of the most highly cited publications were published. This could be due to the topic of the journal being specific to OER, as well as the work by the Open Education Group to encourage rigorous research about OER adoption and publication in journals like *IRRODL* (Open Education Group, 2023). The fields represented by the core journals are all Education and Computer Science. Only 2.9% of the journals of the sampled articles were LIS-specific, and only published 41 of the 1,212 articles. However, academic librarianship overlaps with the field of Education, both as a general discipline and in terms of how articles and journals are indexed. Many academic librarians may publish their research in Education journals in addition to LIS-specific journals because of the overlap with Education or educational research. For example, research that investigates students as the patrons of academic libraries, course-based instruction of academic librarians, or implementing library initiatives as part of the university programs could all be considered educational research.

The most frequently used keywords for articles on this topic, both Author's keywords and KeywordPlus, were iterations of the term *open educational resources* like *OER*, *open education*, and *open education resources*. *Open educational resources* was the most frequently used Author's keyword and was used 50% more than the next most frequent Author's keyword, *open education*. Mishra et al. (2022) found open textbooks to be a declining research area of OER. However, this research found that *open textbooks* was in the top 20 most frequently used Author's keywords, and keywords related to open textbooks made up 1.9% of the total keyword usage. Keywords related to open textbooks were also used in five of the most highly cited articles identified in this study. Research about open textbooks and OER could be declining. But a specific topic like open textbooks in the top 20 keywords with many broad topics, like open education and learning, could mean that it is a niche aspect of the OER research that authors might continue to publish about, though not with exceptional productivity. In addition, it is possible open textbooks may not be differentiated from OER in research studies. Or, as McGowan (2019) found, many institutions do not want to sponsor OER as permanently-funded resources or open textbooks as library resources, which could mean less incentive to publish open textbooks as a subtopic of OER and higher education. Perhaps case studies on open textbooks are less appealing to journals and the home institutions of researchers, whereas topics like OEP and Open Pedagogy that include the creation or use of open textbooks are trending topics.

About 1% of both types of keywords used in the sample of articles were related to libraries, but none were present in the top 20 most frequently used keywords or as keywords for the most highly cited articles. This indicates lower research productivity on OER and higher education in the LIS field. For

example, academic librarians may implement OER initiatives in their libraries but not publish about them. As Smith and Lee (2017) suggest, academic librarians may be unable to add OER initiatives or research to their workloads. It could also be related to the fact that the core authors publishing about OER and higher education are working as professors in Education and Computer Science. The prevalence in the field of Computer Science could be due to how Information Technology overlaps with Library Science and how many OER materials require online accessibility and functionality. The prevalence of core authors in Education could be due to rising textbook costs and tuition as hot-button issues and the encouragement for faculty in Education to implement and experiment with educational initiatives in their research. In addition, there may be more librarians as authors of articles on this topic than this research was able to ascertain. The WOS database assigns at least one subject category to indexed articles. This research found that *Information Science and Library Science* was the 4th most frequently used subject category for articles published on this topic, following two Education subject categories and *Computer Science*. This suggests that there is less library-specific research because of the multidisciplinary nature of academic librarianship, which overlaps with both Education and Computer Science. For example, because the academic library is a logical place to host OER texts and academic librarians can be instrumental in teaching faculty how to utilize OER, research into these roles can easily be considered part of the broader subject of Education as well as Library Science. And Library Science, as an Information Science, can fall under the broad umbrella of Computer Science. More research could be conducted into where academic librarians publish their research, whether in LIS, Education, or Computer Science journals, or journals in their subject speciality. The frequent use of Education and Computer Science subject categories could also represent how libraries are just one vehicle for implementing OER at any academic institution and thus could be a smaller area of research in OER and higher education. More research on publications about OER from academic librarians could shed light on the prevalence of the Education and Computer Science subject categories. It is also important to acknowledge that different types of academic librarians may not have the privilege or be encouraged to publish like librarians with faculty status at well-funded research universities. And as McGowan (2019) found, institutional Teaching and Learning Centers (TLCs) often evenly share sponsorship of OER initiatives. Further investigation could be conducted into whether TLCs are publishing about their OER initiatives.

Conclusion

Open Educational Resources are crucial to creating an equitable environment in higher education. Research on OER has been steadily increasing since 2002, and this data indicates that research has increased significantly in the last six years. This research identified the core authors, core journals, and research topics in the scholarly literature about OER and higher education. The data in this study support that most productivity in research on this topic is in the field of Education followed by Computer Science, though this research did find a presence of LIS scholarship on the topic. Continued research into open textbooks and academic libraries could support more OER initiatives that could help ease the financial burden of college students and it's clear that libraries are a vital research for students seeking affordable school texts. Gathering scholarly publications about OER and higher education could

be a valuable resource for librarians or educators in implementing OER initiatives or providing OER at their institutions.

The results of this research provide a glimpse into the publication data of OER and higher education and the LIS field. Future modifications to this research could involve searching Scopus or LIS-focused databases for articles not indexed in WOS or performing a content analysis, in addition to bibliometric, on the gathered body of scholarly literature. Further modifications to this methodology could provide more opportunities for analyzing the productivity of OER research conducted by academic librarians and the types of journals academic librarians publish in. More bibliometric studies about OER should be encouraged as more years can be added to the publication limitations. Future studies could focus on the COVID-19 pandemic and its effect on OER research and initiatives. As considered by Tlili et al. (2021), future studies would benefit from more quantitative analysis of OER initiatives, specifically those facilitated in academic institutions. In addition, future studies would benefit from identifying the purposes of research studies on OER and if evaluations of OER programs and initiatives present a gap in OER research.

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Conflict of Interest Statement

The author has no conflicts of interest to declare and no financial interest to report.

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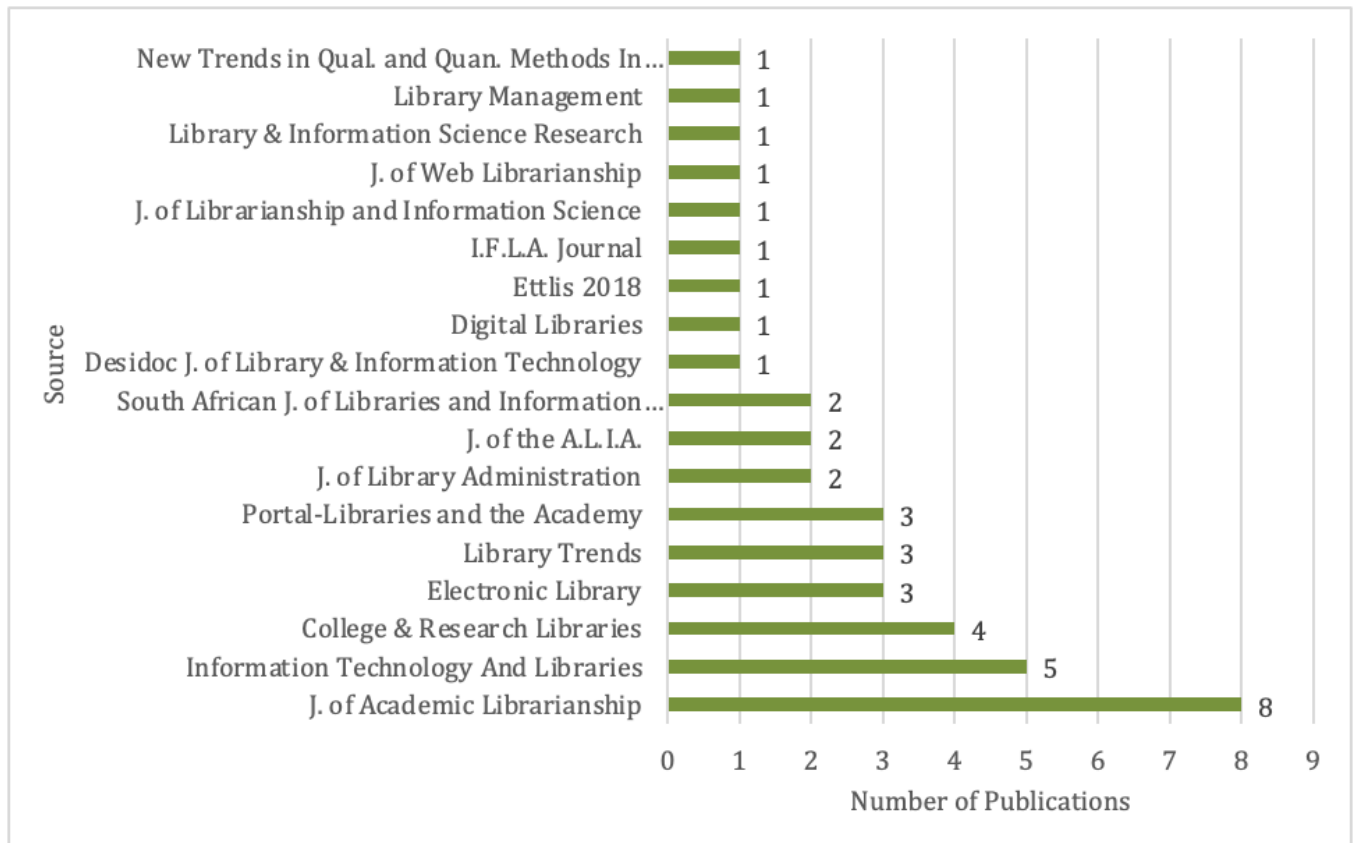
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Appendix

Appendix A. Core Journals and Core Authors

Figure 1.

Productivity of Publication about OER and Higher Education in LIS Journals



Note: The number of publications from 2002 to 2002 in LIS-specific journals of the total 612 journals, n=41 articles

Table 1

Occupation and Research Area of Top 20 Most Prolific Authors

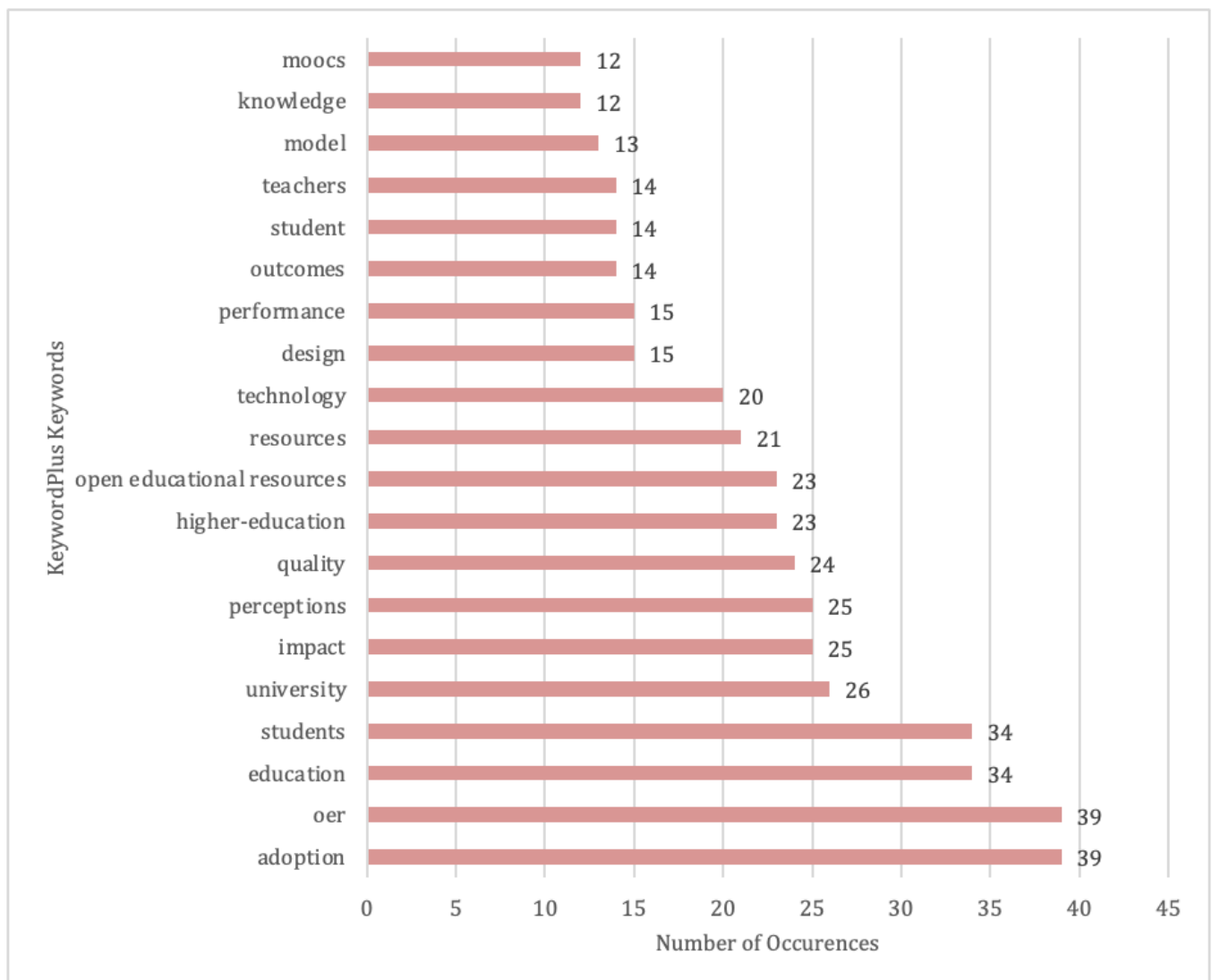
Authors	Articles	Occupation	Area of Focus
Burgos D	19	Professor, Vice-chancellor	Education, Computer Science
Andone D	17	Professor, Director	Education
Nascimbeni F	13	Assistant Professor	Education
Hilton J	10	Professor	Education, Religion
Tzanova S	10	Professor	Education Engineering
Mihaescu V	9	Professor	Education, Computer Science
Tlili A	9	Assistant Professor	Education, Computer Science

Tovar E	9	Professor	Education, Computer Science
Vasiu R	9	Professor, Director	Education, Computer Science
Wiley D	9	Chief Academic Officer, Professor	Education

Note: The top 20 authors, number of articles they published on this topic, their occupation extracted from their ORCID iD and their area of research focus from their Web of Science Researcher Profile.

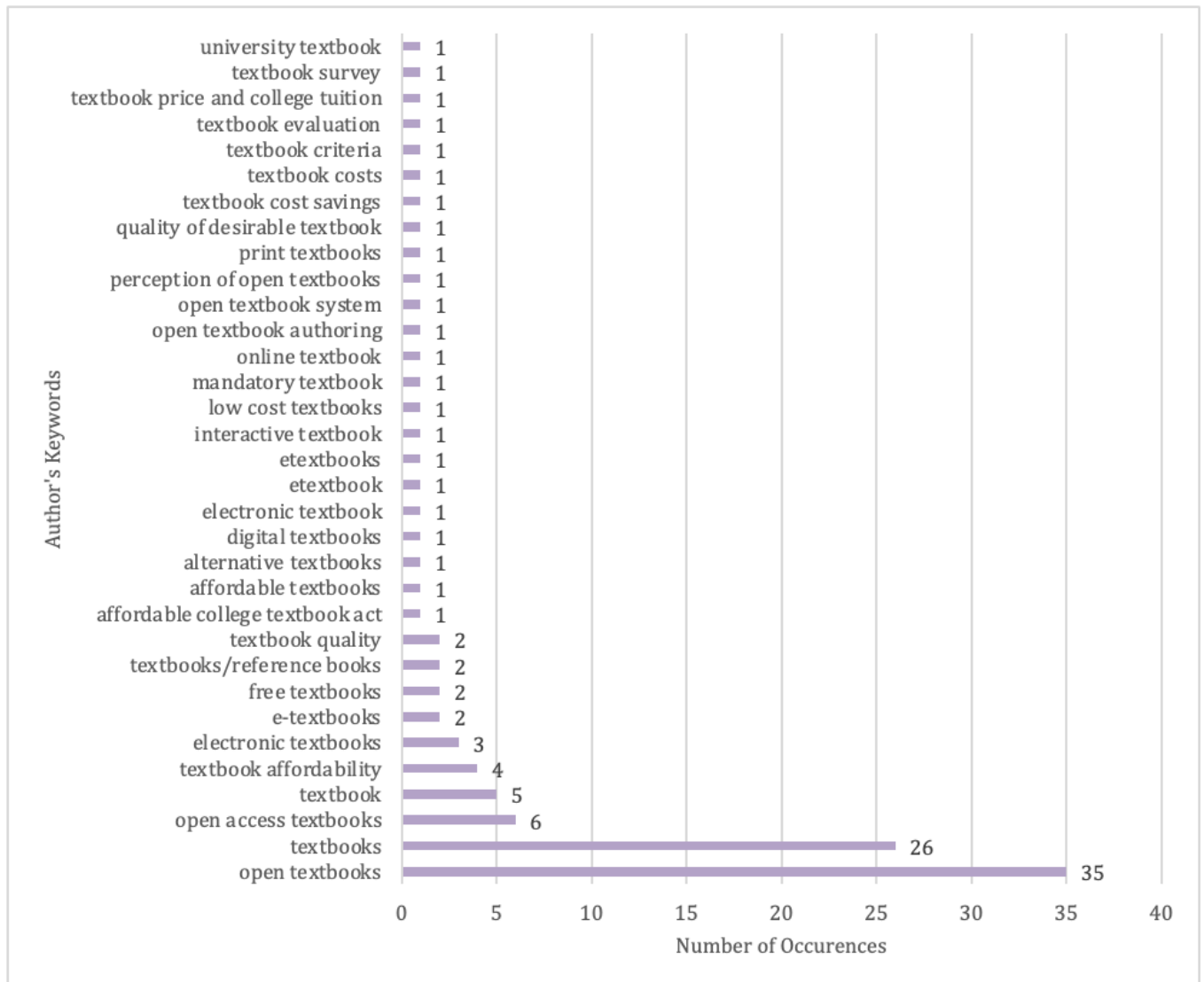
Appendix B. Keywords and Research Topics

Figure 1.
Most Frequent KeywordPlus Keywords



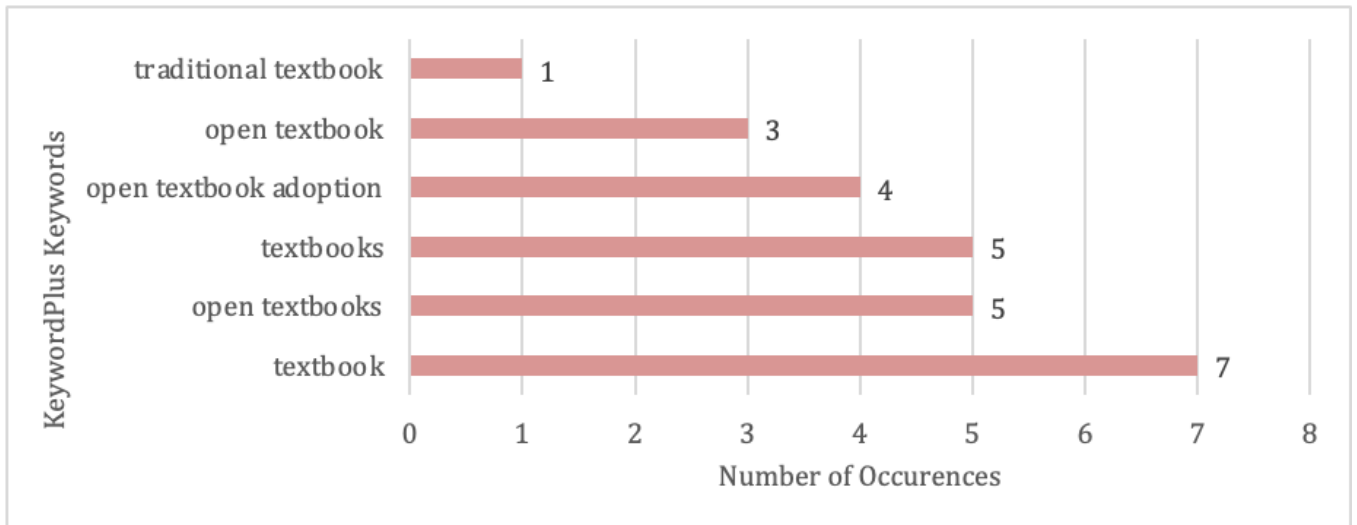
Note: The top twenty most frequently used Keyword Plus keywords and usage, n=547 total Keyword Plus keywords

Figure 2.
Usage of Open-Textbook-Related Author's Keywords



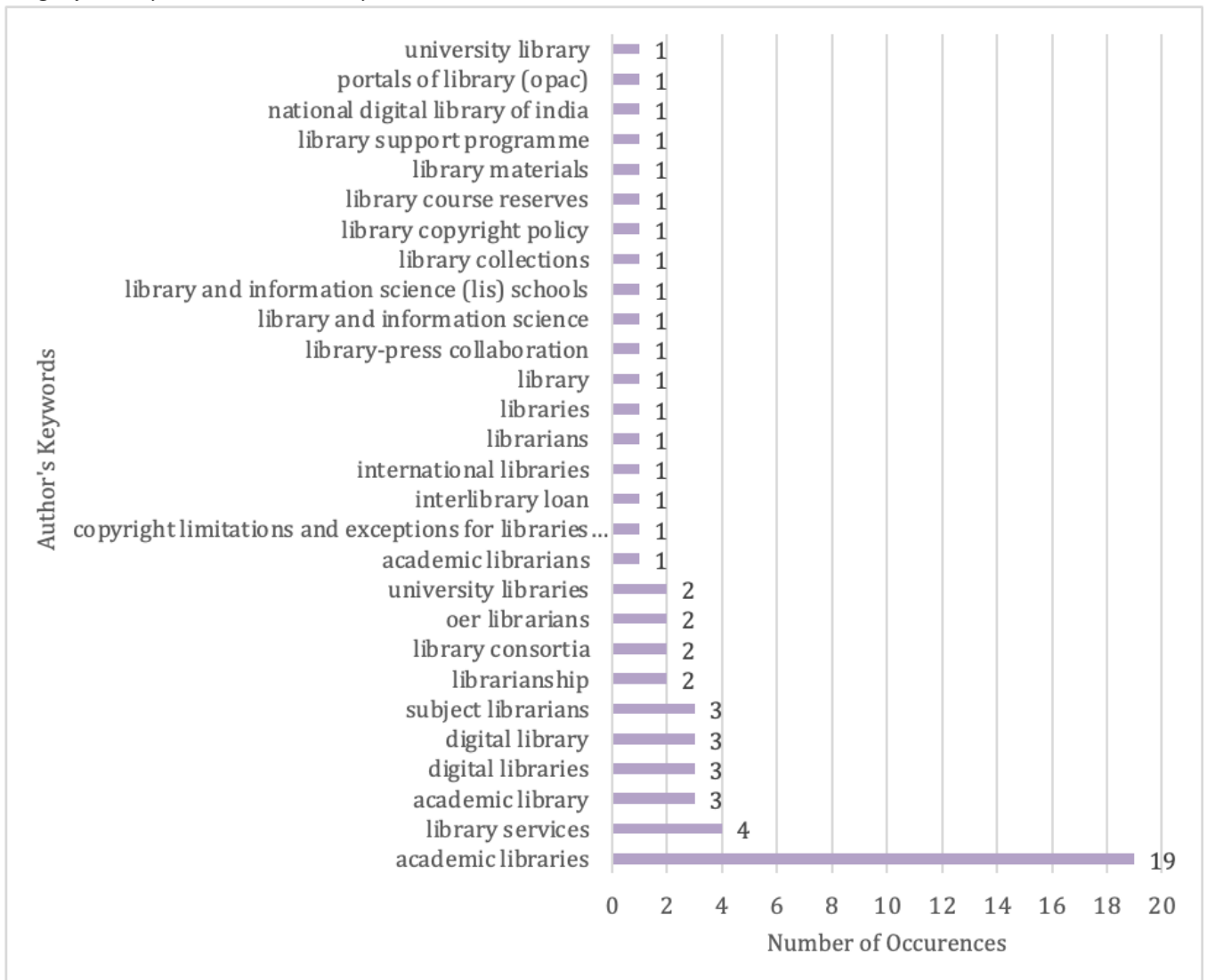
Note: The Author's keywords extracted from the sample about open textbooks and how often they were used, n= 2807 total Author's keywords.

Figure 3.
Usage of Open-Textbook-Related KeywordPlus Keywords



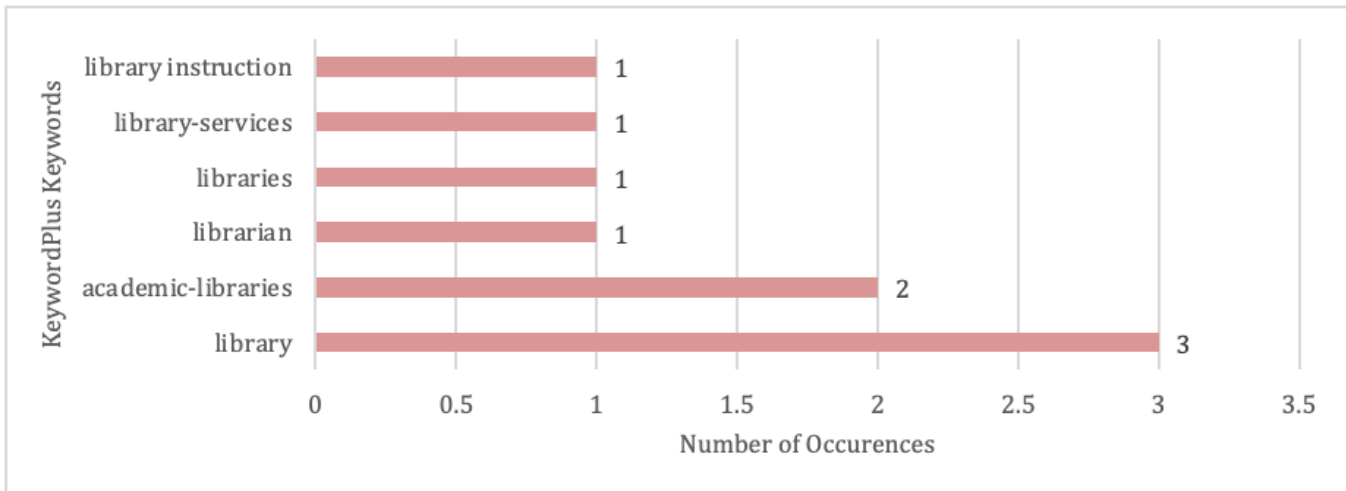
Note: The Keyword Plus keywords extracted from the sample about open textbooks and how often they were used, n=547 total KeywordPlus keywords.

Figure 4.
Usage of Library-Related Author's Keywords



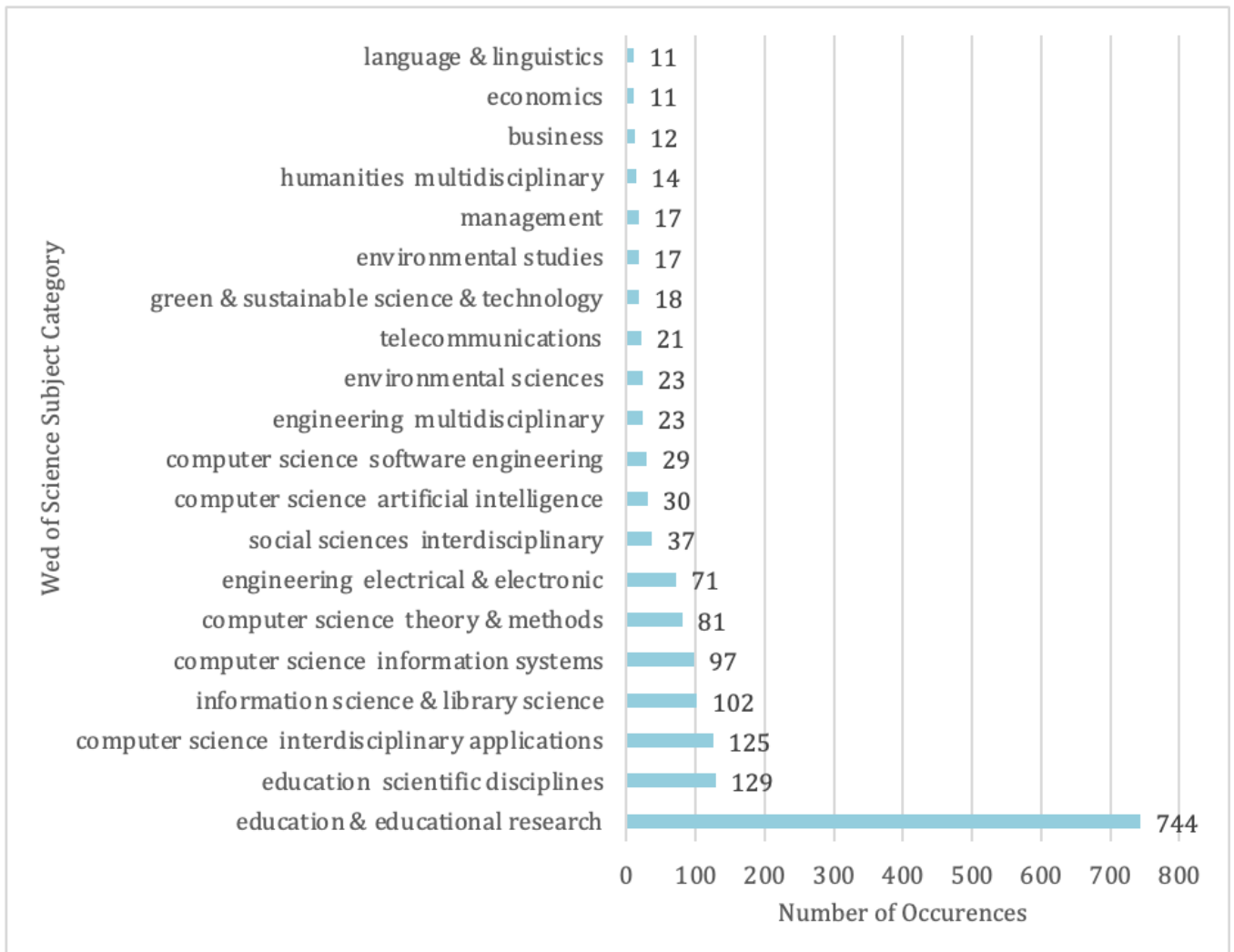
Note: The Author's keywords about libraries extracted from the sample, and how often they were used, n=2807 total Author's keywords.

Figure 5.
Usage of Library-Related KeywordPlus Keywords



Note: The KeywordPlus keywords about libraries extracted from the sample and how often they were used, n=547 total KeywordPlus keywords.

Figure 6.
Most Frequently Used Web of Science Subject Categories.



Note: The top 20 most frequently used Web of Science subject categories and how often they were used in articles in the sample, n=93 total subject categories.