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Review

Knowledge Mapping in the Field of Library and Information Science in Scopus-Indexed Q1 Library Science Journals, 2018-2022

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ABSTRACT

Knowledge mapping has spread beyond library and information science journals and into other fields. To give current insights into scientific literature, it is necessary to study the development of library and information science research. The goal of this study is to examine trends in research subjects in the field of library and information science using keyword occurrences from 2018 to 2022. The research method employs a bibliometric approach, conducting knowledge mapping based on co-occurrence using the VOSviewer application. Data collection techniques involve downloading metadata from international scientific journals categorized under "Library and Information Science" and indexed as Q1 on the Scimago Journal Rank website. Based on the downloaded metadata, the ISSN is used to obtain the metadata of each journal in CSV format from the Scopus. The results of the research indicate that library science studies have expanded into the fields of technology and health, as evidenced by the high occurrence of keywords such as "human" with 1310 occurrences and "social networking" with 732 occurrences.

Keywords
Bibliometrics; Knowledge mapping; Library and information science research.

INTRODUCTION

Library science is a field of study that has experienced significant growth and adaptation through technological advancements. In practice, the existence of technological advances demands the ability of library professionals to adapt in order to provide users with better and more efficient resources, services, and facilities. The current development of library science can be seen through research that connects the discipline with contemporary issues in various fields of study.(1)

In the field of library science, knowledge mapping is highly needed to observe the distribution of knowledge within the scope of current library science studies. Knowledge mapping is important in development, learning, and knowledge dissemination. As a result, knowledge mapping acts as a guideline for obtaining diverse information connected to trends in the field of library science.(2)

There are several methods used for knowledge mapping, one of which is the bibliometric method. Bibliometrics is a method for analyzing literature using statistical approaches. The bibliometric method is a quantitative and statistical method used to describe research patterns.(3) This method can be used for a variety of research topics, sources, regions, and institutions.(4) The bibliometric method is a quantitative method but can be used to make statements about qualitative characteristics.(5) Bibliometrics is a scientific discipline that employs statistical methods and techniques to analyze patterns and outcomes of scholarly publications and citations by researchers within a specific period and region.(6) Bibliometrics is a term that refers to the research and identification of the use of library resources and services, as well as the analysis of the creation of special literature, particularly for authors, publishers, and users.(7) This notion will direct bibliometric research toward co-occurrence mapping. Co-occurrence analysis may be used to determine the number of terms from a study item that occur simultaneously.(8,9)
The implementation of bibliometric methods can utilize supporting tools such as the VOSviewer application. CiteSpace, VOSviewer, and HistCite, which give visual views based on user interfaces; the Bibliometrix package in R, which is based on code commands; and

Pajek and Gephi, which focus on constructing complicated network analysis, are among the many bibliometric analysis tools available. With its excellent visualization skills and ability to load and export information from a variety of sources in order to generate maps based on network data, as well as show and analyze these maps,(10,11) VOSviewer are gaining popularity in bibliometric studies.(12) VOSviewer is a software used to construct and visualize bibliometric knowledge networks, relationships, or mappings among journal articles or journals.(13) The acronym "VOS" in VOSviewer stands for Visualization of Similarities. Web of Science, Scopus, Dimensions, and PubMed files are the four types of bibliographic databases supported by VOSviewer. VOSviewer has text mining functionality that can identify relevant nouns for mapping to determine co- citation and co-occurence within a network.(14)

One of the analyses that can be conducted using VOSviewer to support research is network analysis. Network analysis is a measuring instrument that can aid in researching mapping and highlight potential future research opportunities.(15)

Network analysis using the VOSviewer application can reveal research topics and be used to group or map the knowledge based on the evolving characteristics of writing. The VOSviewer application demonstrates the interconnectedness among library and information science journals by visualizing keywords based on their co- occurrence or frequency of appearance in the keywords written in each article within internationally indexed Q1 Scopus library and information science journals.

Previous research that investigated knowledge mapping in many domains, including library and information science, explored the implementation of knowledge mapping methodologies utilizing bibliometric methods. North et al.(16) has carried out explorations outlined in research entitled "Continuous Professional Development Research in the Library and Information Science: A Bibliometric Analysis and Knowledge Mapping". The study uses a bibliometric method, and the objective of the study is to map the continuous professional development research in LIS (Library and Information Science) which focuses on continuous professional development research in LIS but does not discuss library and information science, especially in subjects. In this case, the study analyzed the publication and citation trends, most productive countries, citation mapping and visualization, citation analysis visualization, most cited articles and citation analysis visualization, authorship patterns and research collaboration, and mapping and visualization of keyword co-occurrence.

Yang and Qu(17) has carried out explorations outlined in research entitled "Knowledge Mapping of Research Data in China: A Bibliometric Study Using Visual Analysis". The study applied the bibliometric method with knowledge mapping of research data in China as the main objective. This study aims to provide a systematic and complete knowledge map for use by researchers working in the field of research data. Additionally, the aim is to help them quickly understand the authors' collaboration characteristics, institutional collaboration characteristics, trending research topics, evolutionary trends, and research frontiers of scholars from the perspective of library informatics. Ashiq et al.(18) has carried out knowledge mapping methodology in LIS explorations outlined in research entitled was titled "Global Research on Library Service Quality: A Bibliometric Analysis and Knowledge Mapping". The author brings the study with the bibliometric method and Library Service Quality (LSQ) in the past five decades (1972-2020) as their objective. The study conducted an analysis regarding publications and citation trends on LSQ from 1972 to 2020, the productive countries in publications and citations on LSQ, the top 10 organizations in publishing research on LSQ, author impacts and publications scores of LSQ research, journal impact of publications and citations, author's bibliographic coupling work, authors with the strongest citation bursts, authorship pattern, author's keyword analysis, highly cited articles, and country collaboration map on LSQ research.(18) In addition, there are several other studies that discuss knowledge mapping in various fields of study.

Pan & Yang(19) in research entitled "Knowledge mapping of relative deprivation theory and its applicability in tourism research"; Li et al.(20) in research entitled "Knowledge Mapping of the Rural Teacher Development Policy in China: A Bibliometric Analysis on Web of Science"; Huang et al.(21) in research entitled "Knowledge mapping of an artificial intelligence application scenario: A bibliometric analysis of the basic research of data-driven autonomous vehicles"; Xiong et al.(22) in research entitled "Global knowledge mapping and emerging trends in Helicobacter pylori-related precancerous lesions of gastric cancer research: A bibliometric analysis from 2013 to 2023"; and Wang et al.(23) in research entitled "A review of applied research on low-carbon urban design: based on scientific knowledge mapping".

Based on review of previous studies, these studies have similarities in the application of research methods and analysis. The researchers in these previous studies utilized a bibliometric approach to conduct their research, and the main analysis of these studies was knowledge mapping. The difference found through the review of previous studies is in the focus of the researcher's analysis of the study results. The current study focuses on analyzing the mapping of research topic trends in the field of library and information science based on the co- occurrence of author keywords and index keywords in journal articles.

Based on the visualization of knowledge mapping, this research divides the results of the knowledge mapping analysis into three parts (clusters), namely the Library.

Science, Library and Information Technology, and Library and Health clusters. Meanwhile, previous research that has been reviewed has a broader focus, such as research conducted by Ashiq et al,(18) which not only analyzes knowledge mapping but also analyzes the most productive countries, the most cited articles, and citations, as well as patterns of authorship and research collaboration. Previous research conducted by Yand and Qu also has significant differences with the current research in terms of the results of the analysis in the discussion of authors' collaboration characteristics, institutional collaboration characteristics, trending research topics, and evolutionary trends and research frontiers.

Furthermore, the analysis conducted by Ashiq et al.(18) also has an analysis that extends towards productive countries in publications and citations on LSQ, top 10 organizations in publishing research on LSQ, author impacts and publications score of LSQ research, journal impact of publications and citations, author's bibliographic coupling work, authors with the strongest citation's bursts, authorship patterns, highly cited articles, and country collaboration map on LSQ research. The difference compared to the current research,

previous study had a broader focus and objective in terms of discussion analysis.

The current research being conducted uses knowledge mapping as its primary object for research analysis to identify progress and shifts in literature sources, specifically scientific article, in the field of library and information science. Utilizing bibliometric methods for knowledge mapping can prove advantageous for both researchers and practitioners, ensuring they remain follow of the latest developments in the fields of library and information science. This approach facilitates a comprehensive understanding of the evolving landscape in these domains. Furthermore, researchers believe the vital significance of knowledge mapping research as a fundamental resource for upcoming researchers to know trends in topics within the domain of library and information science.

Additionally, this kind of research helps aspiring researchers understand shifts in the patterns of study topics or connections between their field of study and other disciplines. As demonstrated in ongoing research, such connections may exist between libraries and information science, information technology, and health. The application of bibliometric methods in knowledge mapping can be beneficial for researchers and practitioners to stay updated with advancements in the library and information science fields.

Methods

The research methodology was designed to illustrate the stages undertaken throughout the research activities. The adopted methodology is a descriptive quantitative approach utilizing bibliometric analysis, enabling the mapping and analysis of trends and patterns within scholarly literature.

Data Source

The data used in this study were obtained from the Scopus database, focusing on publications in the "Library and Information Science" subject category. Scimago Journal Ranking was used as a tool to identify international journals with a Q1 ranking, indicative of high citation levels and influence within the field.

Data Collection Technique

The data collection technique commenced with the selection of metadata from Q1- ranked journals in the "Library and Information Science" category listed in the Scimago Journal Ranking. The data selection was conducted on February 18, 2023, focusing on metadata that included the journal names and ISSNs. Each ISSN was used to access and download the corresponding metadata from Scopus. The CSV (comma-separated values) format was chosen to facilitate the ease of data analysis and manipulation.

Data Processing Technique

The data obtained from Scopus were processed using the VOSviewer application for visualization. This analysis involved the use of index keywords and author keywords from each journal. The visualization process was conducted for each individual journal and for the aggregate of all keywords. In determining the threshold or the minimum number of keywords for visualization, this study referred to the average number of keywords found in the author guidelines of each journal. This approach was adopted because, during the review of article writing guidelines, it was observed that several articles did not specify a minimum keyword requirement. Consequently, we decided to sum up the minimum keywords where specified and then compute an average to establish a standard baseline for our analysis (Tables 1, 2).

After performing the calculations, the average number of keywords was found to be approximately 5.72. For the purposes of the data visualization process, the researcher chose to round this average up to 6 to set a minimum threshold for keyword occurrences. The data visualization process was divided into two parts. The first stage was visualize each journal, in which the available keywords are used to build a unique visual representation for that journal. This stage identifies the association between terms in a certain journal.

After downloading data from 61 journals and conducting visualizations for each using VOSviewer, the researchers analyzed the resulting visualizations. The results of the analysis and review of article abstracts show that journals in the 'Library and Information Science' category were not limited to topics on libraries and information science but also explored other fields, including health and technology. Therefore, the researchers decided to categorize these journals into three main clusters based on their primary focus (table 3).

The second step of the visualization process is for clustered journals. At this step, clustered journals will be analyzed using a combination of selected keywords to visualize relationships and patterns. By dividing the visualization process into these two steps, researchers can gain more comprehensive insights, both at the level of individual journals and at the level of all journals involved in research.

Results

Based on data collection from 61 international journals obtained from the Scopus Database in the field of "Library and Information Science", researchers grouped these fields of study into 3 clusters: Libraries, Libraries and Information Technology, and Libraries and Health. This grouping was carried out because, based on the visualization results, the researcher found that there were several journals that expanded into other fields of science, namely technology and health.

Trends in Research Topics

Article Publication Trends in the Library Science Cluster

The mapping visualization conducted by the author focuses on the frequency of keyword co-occurrence, which includes both author-supplied keywords and index keywords. Based on the network visualization analysis of the 'Library Science' cluster (fig. 1), there are visualizations consisting of nodes of various sizes. The larger a node's size, the more frequently that keyword is mentioned in library and information science research from 2018 to 2022. Conversely, smaller nodes indicate that a keyword has been less researched and may have the potential to become a trending research topic in the future.

After examining the visual data of the Library Science cluster (fig. 1), the researcher conducted a mapping analysis that incorporated

all keywords. This analysis resulted in 848 keywords, and categorized into 8 clusters. These clusters encompass a wide range of research areas within the field, and each defined by the frequency and co-occurrence of its constituent keywords.

The categorization of keywords into clusters as shown in the table 3 reveals that 'academic libraries,' 'information literacy,' and 'bibliometrics' are the three highest- ranking keywords with occurrences of 420, 357, and 273, respectively. The high frequency of these keywords indicates their prevalence in library and information science journal articles from 2018-2022. This suggests that these areas have been focal points of research and discussion within the academic community during this period.

The overlay analysis applied to the Library Science cluster (fig. 2) reveals nodes with bright colors. Bright colors indicate recent keywords that are trending research topics, while dark colors represent keywords associated with past research topics. This suggests that nodes with bright colors signify research areas with keywords that are currently less explored, holding potential to evolve into trending research topics in the future.

Article Publication Trends in Library and Information Technology Clusters

Based on the visualization of the "Library and Information Technology" cluster (fig. 3), the mapping results were obtained using analysis based on all keywords, and 1,000 keywords were obtained, which were grouped into 5 clusters, including (table 5):

The network visualization of the Library and Information Technology clusters reveals that the most prominent keywords within these clusters are 'social media,' 'social networking (online),' and 'design/methodology/approach,' which appear with the highest frequencies of 911, 732, and 465 occurrences, respectively.

Using overlay visualization (fig. 4), the research keyword trend for 'social media' stands out with a brighter color compared to the keywords for 'social networking (online)' and 'articles.' The difference in color brightness indicates how research interest in the field has shifted over time. More specifically, it highlights that scientific interest in 'social media' began to increase from the end of 2020.

Article Publication Trends in Library and Health Clusters

Based on the visualization of the "Library and Health" cluster (fig. 5), the researcher conducted a mapping using analysis based on all keywords and obtained 1,000 keywords, which were grouped into 5 clusters, including (table 6):

The keyword analysis within the Library and Health cluster underscores that 'human' is the term with the highest frequency of occurrence, signifying that these topics have emerged as prominent research trends in the Library and Health sector from 2018 – 2022. The prominence of the term 'human' in the Library and Health cluster is indicative of a strong focus on research that is centrally concerned with various aspects of human health and well-being.

Utilizing overlay visualization (fig. 6), a distinct trend has emerged, with 'COVID-19' appearing as one of the most prominent keywords, highlighted by its brighter color compared to other terms in the dataset. The intensity of the color associated with 'COVID-19' suggests a surge in research activity related to the pandemic, especially from the end of 2020.

Discussion

Article Publication Trends in the Library Science Cluster

The visualization produced (fig. 1) shows the dominance of the keyword 'academic libraries' in research, reflecting its dynamic role in the evolution of knowledge. This is exemplified in the study "Information technology and changing role models in German libraries: The example of OPEN-CAM" by Raak et al,(24) which illustrates how digital transformation can alter the structure of libraries in Germany.

In table 4, within the Library Science cluster, the keyword 'COVID-19' emerges, reflecting significant changes in academic libraries during the pandemic period from 2018-2022. The following articles found within the Library Science cluster demonstrate the connection between 'academic libraries' and 'COVID-19':

a. The article "Pandemic Information Access Challenges and Expectations about the Post-COVID Era: A Survey of Pakistan Students' Opinion Regarding Academic Libraries' Services and Staff" by Batool et al.(25) which reveals the challenges faced by students in accessing information from academic libraries during COVID.

b. "Academic library spaces and student activities during the COVID-19 pandemic" by Kim & Yang(26) shows the impact of the pandemic on student library use and analyzes the environments needed to effectively support student learning activities.

c. The study "Technical practices used by information literacy and media information literacy services to enable academic libraries to handle the COVID-19 Pandemic" by Ortega et al.(27) analyzes the techniques and changes implemented by universities in response to the COVID-19 crisis, specifically in enhancing Information Literacy (IL) and Media Information Literacy (MIL) programs.

Based on the overlay visualization (fig. 2), the author can identify keywords that have the potential to become trending within the Library Science cluster by observing the small nodes with bright yellow color. The predicted keywords to trend based on the VOSviewer overlay visualization include:

a. children's literature
b. school librarian
c. information experience
d. information creation
e. records management
f. information access
g. artificial intelligence
h. community engagement
i. maker spaces

Article Publication Trends in Library and Information Technology Clusters

In the "Library and Technology" mapping, keyword analysis showed that 'social media' emerged as the keyword with the highest frequen-

cy. This reflects a growing research trend where social media was not only seen as a common communication platform but also as a vital tool in supporting learning and education. The focus on social media in library research shows a response to the digital shift and how libraries are adapting to new technologies to meet the needs of their dynamic users.

The article by Alalwan(28) provides empirical evidence on how educational institutions are adopting social media to enrich the learning experience. It shows that libraries and information technology no longer operate in silos but are integrated with each other, with social media being a strategic tool to increase student engagement and participation.

The presence of these keywords in current research reflects the importance of understanding the dynamics of social media use in academic contexts and exploring its full potential as an educational medium. It also highlights the role of libraries as active knowledge mediators in creating and managing new spaces for learning and collaboration.

Based on the overlay visualization (fig. 4), the author can identify keywords that have a chance to become trending keywords in the Library and Technology cluster by looking at the size of small and bright yellow nodes. The prediction results of keywords that will trend based on VOSviewer overlay visualization include:

a. decoding
b. signal encoding
c. upper bound
d. encoding (symbols)
e. code
f. machine learning
g. misinformation
h. generator
i. block codes
j. linear codes
k. task analysis

Article Publication Trends in Library and Health Clusters

According to the keyword mapping results in "Library and Health" cluster, the term 'human' appears to be the most dominant, indicating a research focus on human interaction with information and technology. This phenomenon is reflected in information-seeking behavior and the use of technology in libraries, as well as the human ability to find information. For example, the article "Information seeking behavior differences indicate which US population groups lack information about human papillomavirus and associated cancer risks" by Ansari(29) explores health knowledge gaps, specifically about cervical cancer.

In addition, keyword mapping highlighted the presence of terms such as 'chemistry', 'molecular dynamics', and 'genetics', reflecting the library's role as a cross- disciplinary resource center, not just limited to library science. An example is the article "ePharmaLib: A Versatile Library of e-Pharmacophores to Address Small- Molecule (Poly-)Pharmacology" by Moumbock et al,(30) which focuses on the development of bioactive compounds using digital libraries for analysis.

Based on the overlay visualization (fig. 6), the author can identify keywords that have a chance to become trending keywords in the Library and Health cluster by looking at the size of small and bright yellow nodes. The prediction results of keywords that will trend based on VOSviewer overlay visualization include:

a. COVID-19
b. pandemics
c. SARS-COV-2
d. literature searching

The keywords indicating a trend are related to scientific terms in the health sector, not Library Science. Therefore, the keyword recommendations can be used by researchers in the health sector to identify what scientific subjects are still rarely researched so that they need further development and have the opportunity to trend in the future.

Future Research

This study can serve as a guide or a point of reference for the development of future research to explore and analyze knowledge trends in the publications of library and information science journals, library and health, or library and technology. Moreover, researchers hope in the future can adapt this bibliometric analysis to other fields of knowledge, including health, technology, social sciences, and more, based on their specific needs. This is due to the changing and broadening scope observed in the current research falling under the category of knowledge mapping in library and information science, as revealed in the current study's analysis. This shift indirectly poses challenges in determining the outcomes of the current research analysis.

Conclusions

This research reveals the trends in research topics within library and information science. In the "Library Science" cluster, the keyword 'academic libraries' frequently appears, indicating its significant role in the evolution of library science. The study also highlights the impact of 'covid-19' on academic libraries, focusing on the challenges faced by students and library staff during the pandemic. Moreover, visualization results suggest that topics such as 'children's literature', 'school librarian', and 'artificial intelligence' might become important research trends in the future. In the "Library and Technology" cluster, 'social media' emerges as a key keyword, showing how libraries are utilizing social media for education and learning purposes.

Future trend predictions in this cluster indicate that health topics like 'machine learning' and 'misinformation' may gain more importance to be discussed in relation to libraries. In the "Library and Health" cluster, 'human' is the main focus, underscoring how people interact with information and technology in libraries. Future trend predictions in this cluster indicate that health topics like 'COVID-19' and 'pandemics' may gain more importance. This research helps researchers and practitioners understand which topics are currently trending and which are likely to become significant in library and information science.

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Conflict of interest

The authors declare no conflict of interest.

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