Technology innovation in library: a bibliometric review

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Abstract

Technological innovation is changing libraries and how libraries operate. This study presents a bibliometric analysis to identify key patterns and trends in research on technological innovation in libraries, based on the publication of papers indexed in Web of Science from 2019 to 2023. A total of 433 documents from 342 sources were analyzed using Biblioshiny and VOSViewer software. The results show an increasing interest in this research domain, despite a negative annual publication growth rate of -32.33% in recent years. The IEEE Winter Conference on Computer Vision Applications and the IEEE Symposium on Security and Privacy were the most productive sources. "Library" was the most frequent keyword found in 6% of documents, along with terms such as "model", "performance", and "system", highlighting the focus on developing and evaluating technological systems for libraries. The findings summarize the key topics, trends, and leading countries driving technology innovation research for libraries over the past five years. This bibliometric review provides insights to guide future research efforts in this area.

Keywords: bibliometric, innovation technology, library

INTRODUCTION

Nowadays, the developments and innovations of science and technology are always occurring all the time and can be found in our daily life. Moreover, the development of science and technology happens in various aspects in people's live, such as in the field of social, economic, political, cultural to education (Achrub, 2018). The increasing of human needs in all aspects of life are the main impetus for the development of science and technology (Aditya, 2020). In addition to this, the development of science and technology that occurs then encourages people to change in life, such as how to work, how to interact, and how to learn. Also, Surajiyo and Winarni (2021) on their research about the relationship between science with technology, explained that the development of science and technology began to be applied from the drive to facilitate human life.

The development of science and technology took place in various areas of society, including the field of education. Through the developments in science and technology in the field of education, it makes the learning process can be very easy. This was mentioned by Fitriani (2021) on her research on the development of science and technology in the field of education, where science and technology significantly affect the way a student learns, the way teachers teach, and learning materials that are always being renewed. The encouragement of

the development of science and technology in the field of education helps the learning process using modern techniques of learning in which the role of science and technology is a facilitator. From this case, the learning process can then be implemented effectively and efficiently (I Ajizah & M Munawir, 2021).

Libraries have a role as a source of education and the occurrence of scientific and technological progress (Irfan & Fitriasi, 2018). With the development and innovation of science and technology that occurs, it leads the library to the way the library works in a meaningful way. The development of science and technology encourages libraries to be able to keep up with and implement scientific and technological innovations in all activities in the library. Therefore, the main purpose of the library in providing information needed by users can be maximized. Technological developments that can be implemented by libraries can encourage library upgrades in the form of a digital platform (Lee, 2020).

Innovative library can be developed by utilizing current technological advances (MM Ridwan, 2021). One of the utilizations of science and technology that helps libraries in improving their services to users is the implementation of a robotics system. This Robotics System utilizes ideas such as humanoid robots that offer visitors the choice of picking up books by themselves or doing it with the help of a robot (KP Ramadhani, 2020). It is also mentioned in research conducted by DR Aulianto (2020) on the use of technology in libraries using Augmented Reality and Virtual Reality that each of these technologies can be applied. Augmented Reality can be used as the creation and reading of interactive OPAC brochures, library collection displays, searching for library collections on shelves with AR, and interactive user learning materials. As for the installation of Virtual Reality technology, it can be useful for information literacy, online catalogs, library services, and tours.

The application of technological innovation in libraries also occurs in libraries at the university level, as in the research conducted by Kim, et al. (2021) regarding the application of technological innovation in several university libraries, including McGill University Library, Nanyang Polytechnic (NYP) University Library, Korea National Open University Library, and North Carolina State University Library. Libraries in these universities provide interactive services by utilizing technology, such as to provide content curation and even modified library services in hunting. Another research conducted by Yu, et al (2019) successfully created findings in the form of mobile robots that can help run library management. Based on this research, the mobile robot is able to recognize target books autonomously, has a high level of fault tolerance, and is even able to complete the shelving process.

Technological innovations that can be applied in various libraries are certainly successful after going through various stages of testing and long consideration. Fatmawati (2018) states that technological innovations in a library have their own uniqueness so that they must go through the analysis stage first to be applied to the library.

In the analysis process carried out to implement technological innovation in the library will find one or maybe several obstacles. The obstacles that will be faced can be obstacles from the environment related to institutions, systems and even obstacles related to resources (Chuang, et al., 2019). Furthermore, (Chuang, et al, 2019) stated in their research that organizational barriers related to resources and leadership are the biggest barriers to technological innovation.

There are several studies that form the basis of this research. The first research is research conducted by (Pinto, et al., 2019) which discusses bibliometric analysis of scientific production on Mobile Information Literacy and Mobile Learning from 2006 to 2017. In his research, the data analyzed were data in the form of journal papers and conference proceedings obtained from several databases, including ERIC, LISA, Library, LISTA, Scopus, and Web of Science. Other bibliometric research that supports this study is research conducted by (Pinto, et al. 2019) regarding bibliometric analysis of scientific publications related to mobile information literacy in higher education. As data, the study utilized several sources as databases, including: Web of Science, Scopus, LISA, LISTA, and ERIC with scientific publications from 2006 to 2017.

Research related to technology innovation in libraries is evidenced by several scientific publications in the application in this field. However, of the few scientific publications on technological innovation in libraries that have been found, there are no scientific publications that specifically discuss technological innovation in libraries. Furthermore, scientific publications with a focus on discussing proceeding papers in the field of technological

innovation in libraries that have been indexed by Web of Science were also not specifically found. Therefore, in this study, the authors chose to discuss the development of proceeding papers publications indexed by Web of Science that occurred during the period 2019 to 2023. Based on this explanation, the research question in this study will explore specific trends related to scientific publications, especially proceeding papers in the context of technological innovation in libraries, which are formulated as follows:

– RQ1. How is the development of research, especially in the proceedings of papers that occur in technological innovation from 2019 to 2023?

In relation to the research question above, this study will observe the development of scientific publications with a focus on the form of paper proceedings that occur during 2019 to 2023 regarding technological innovations in libraries. There are several factors that will be considered by the analysis, such as the author, source of the document, and others.

– RQ2. How is the relationship related to technological innovation research that occurs in libraries?

The research question above will be answered by analyzing related keywords, authors, and countries that contribute to research related to technological innovation in libraries. The results of the research will be based on the results of research in the form of a proceeding paper.

Bibliometric analysis became the method used by the authors in this study. Bibliometrics is a method used to conduct analysis of scientific publications in a particular field statistically (Muhammad, Marchy, Rusyid, &; Dasari, 2022). Bibliometric analysis provides mapping in visual form containing information about a field of research according to its criteria, ranging from based on authors, agencies, correlations between countries, keywords, documents, and many others This study was conducted to find out how the development of trends related to the application of technology in the library field throughout the country. The analysis used in this study is bibliometric analysis by utilizing Biblioshiny-RStudio and VOSViewer software. The database used is a proceeding paper that indexed by Web Of Science and with bibliometric indicators such as keywords that have a high frequency of occurrence, number of publications, publication year, correlation between keywords, and also collaboration between countries that are established related to this research.
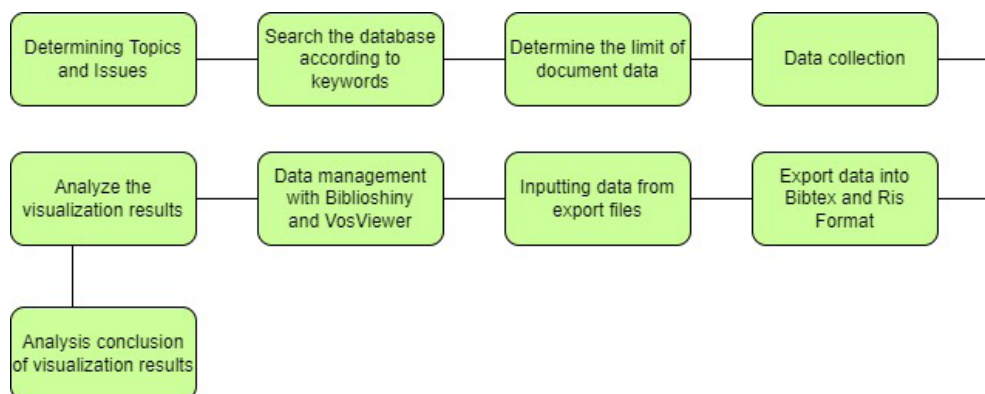
METHODS

Figure 1. Research Method Flowchart

Figure 1 shows a visualization of the development of bibliometric research related to Technology Innovation in Library. The first step starts with choosing the subject and issue to be researched with the help of bibliometric applications, namely Biblioshiny and also VOSViewer. Then search the *database* on the Web Of Science platform using two keywords, namely "technology innovation" and "library" using the Boolean operator "AND". From the search results with these two keywords, a total of 10,293 scientific documents were obtained accessed on December 27, 2023.

The database retrieval process that will then help for this analysis is 746 documents from 10,293 documents. Then the author conducted a manual screening and obtained 736 documents from 746 documents. The data retrieval process carried out from the filtering results will be exported with the Bibtex file format for the Biblioshiny software and RIS file format for the VOSViewer software. The results of the export file in each application are inputted according to the format then carried out data management and data visualization from the database. Mapping and analysis with Biblioshiny software will be carried out based on Most Relevant Sources, Author Productivity Through Lotka's Law, Most Global Site Documents, TreeMap, Trend Topic, and also Co-occurrence Network. From all the data visualizations that have been analyzed, conclusions will be made.

FINDINGS AND DISCUSSION

Findings

Table 1 shows information about the results of summarized data related to research on technological innovations that occur in libraries. The data is taken from the publication of proceeding papers that have been indexed by the Web of Science which are processed using Biblioshiny - RStudio. During the period 2019 to 2023, 433 documents have been published from 342 sources, such as journals, books, and various other sources. The data in the table also shows that in each year, the growth of publications that occur in this field reaches a minus with a percentage of -32.33% and the average age of each document is 3.73. There are no references recorded in the data related to technological innovation research in libraries. Documents in the data are divided into two categories with different numbers of publications, namely articles; proceeding papers with 14 documents and proceeding papers with a total of 419 documents. During this time period, 1,536 authors have produced 433 documents with 32 documents written by one author and as many as 401 other documents written by more than one author. The data in table 1 also shows that the keywords generated from all authors totaled 1,453 keywords and 269 keywords plus.

Tabel 1. **Main Information Data**

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2019:2023
Sources (Journals, Books, etc)	342
Documents	433
Annual Growth Rate %	-32,22
Document Average Age	3,73
Average citations per doc	2,744
References	0
DOCUMENT CONTENTS	
Keywords Plus (ID)	269
Author's Keywords (DE)	1453
AUTHORS	
Authors	1536
Authors of single-authored docs	32
AUTHORS COLLABORATION	

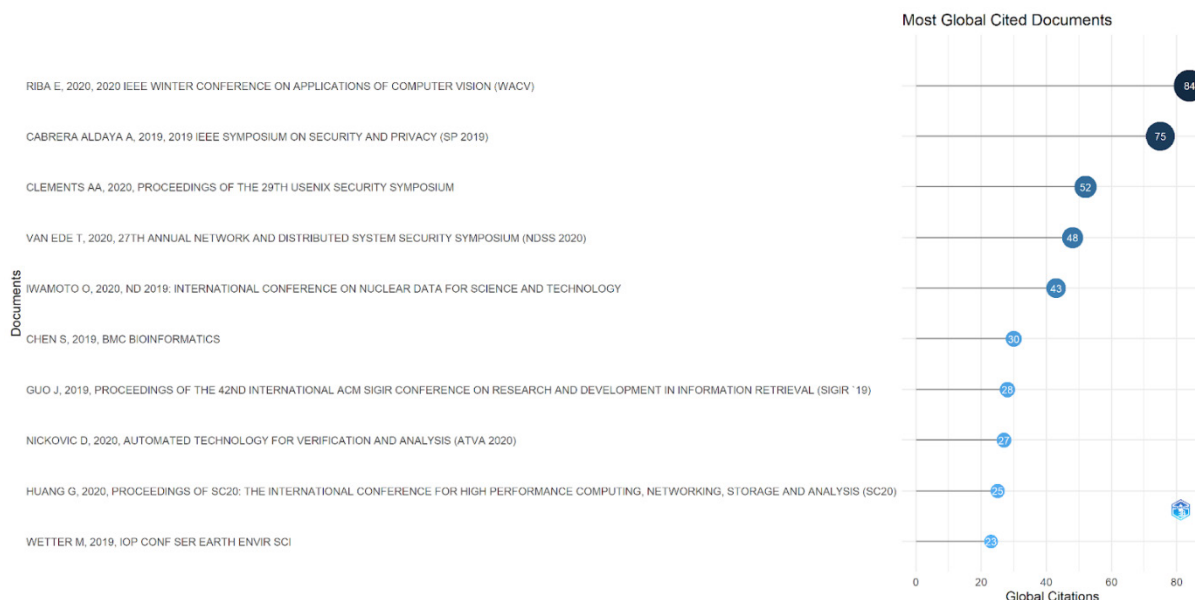| Single-authored docs | 32 |
Co-Authors per Doc	4,16
International co-authorships %	21,02
DOCUMENT TYPES	
article; proceedings paper	14
proceedings paper	419

Figure 2. Most Cited Documents

In the visualization results of most site documents with the topic of technological innovation that occurred in the library in the last 5 years, from 2019 to 2023, it can be seen that the conferences and symposia that published the most articles related to library technology innovation were the IEEE Winter Conference On Application Of Computer Vision (WACV) and the IEEE Symposium On Security And Privacy (SP 2019). IEEE Winter Conference is the most popular site with the highest number of library technology innovation documents, which is around 84 documents with an annual TC of 16.80 from 2019 to 2023. IEEE Winter Conference On Application Of Computer Vision (WACV) occupies the first position with about 84 publications related to library technology innovation. IEEE Winter Conference On Application Of Computer Vision (WACV) and IEEE Symposium On Security And Privacy (SP 2019) took first and second place with about 84 and 75 articles published, respectively. Both are important avenues for the publication of library technology innovation articles, especially those from the conference and symposium domains. By looking at these publishing patterns, we can analyze which proceedings, conferences and journals are most relevant as targets for library technology innovation research publications.
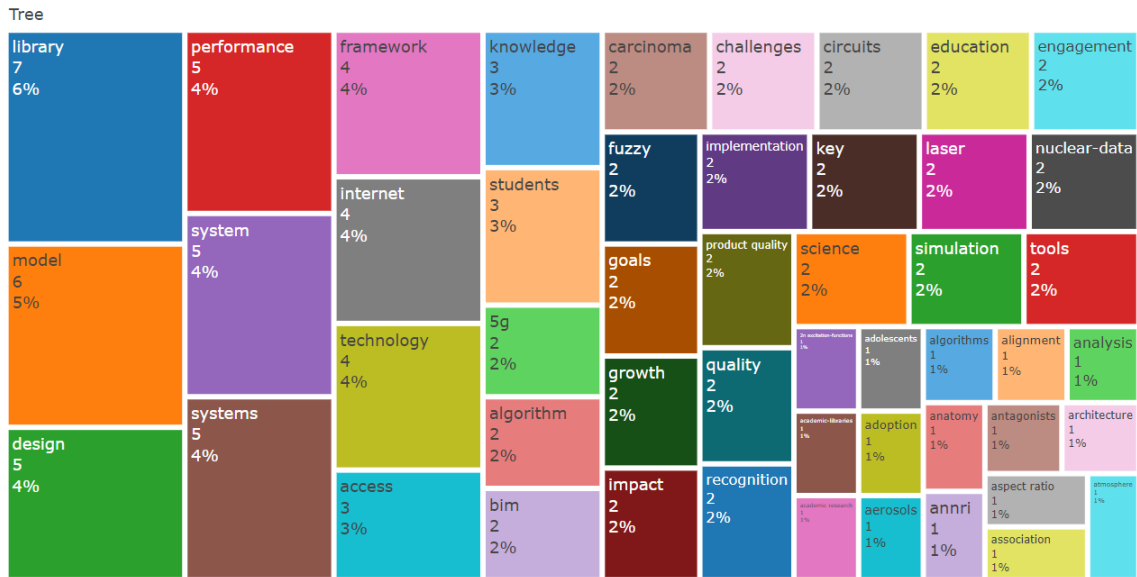
Figure 3. Tree Maps

Based on the TreeMaps visualization above, the publication of proceeding papers in the field of library technology innovation in the last 5 years, namely from 2019 to 2023 shows that keywords with the keyword "library" have more frequency than other keywords, which is 6% with 7 documents. In addition to the library keyword, the keyword that has the next highest frequency is the word "model" which has 6 documents with a percentage frequency of occurrence of 5%. The words "performance", "system", "systems", and "design" have the same frequency of occurrence, both in terms of the number of documents, which is 5 documents each, and in percentage, which is 4%. "framework", "internet", and "technology" each appeared in 4 documents with a percentage of 4%.
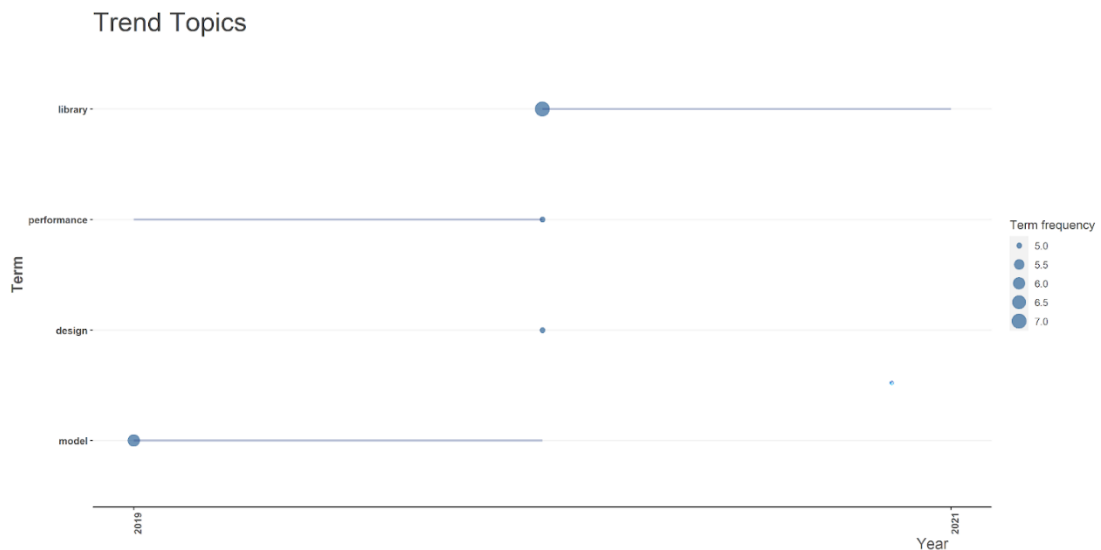

Figure 4. Trend Topics

Based on the image above, visualization of topic trends, a number of authors have studied subject patterns related to the main theme of the Technology Innovation Library. The keywords performance, model, design and library shape the trend of this topic. The Performance keyword has a frequency of 5.0 in 2020. And the model keyword has a frequency of 5.5 in 2019. The keyword Library has a large frequency in 2020 of 7.0. Thus, it can be applied in future research that will help in identifying keywords related to the Technology Innovation Library,

which will reduce the amount of time it takes to get data from the search platform's database. The topic trends that have been put forward (performance, model, design, and library) can help future research in identifying themes related to library technology innovation studied in the last 5 (2029-2023) years.
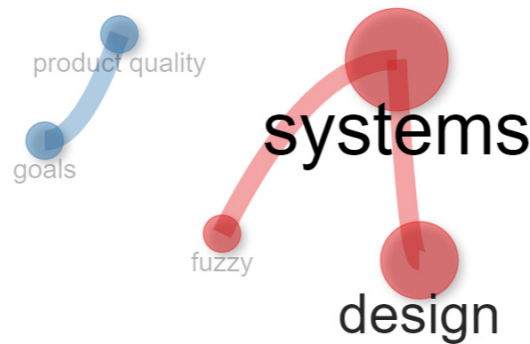

Figure 5. Co-Occurrence network

In the co-occurrence network visualization of library technology innovation topics from 2019 to 2023, several interconnected keyword clusters are visible. The largest cluster is formed by keywords such as model, performance, design and library. The large node size of these words indicates that these sub-topics are the most dominant and popular in library technology innovation research. The strongest relationship is shown by the thick line between design and system nodes. This is very reasonable because the design and system of a library are very often researched and developed by researchers of technological development innovation in libraries who will continue to innovate so that libraries can also develop following the development of existing technology to date. In addition, the emergence of nodes with fuzzy topics, product quality, and goals in the visualization results also shows the development of new sub-topics in library technology innovation. Overall, the co-occurrence network of library technology innovation topics is dominated by system and design. These two fields seem to be the areas that have benefited the most from advances in library technology in the last 5 years (2019-2023). This pattern can provide insight into the future direction of library technology innovation research.
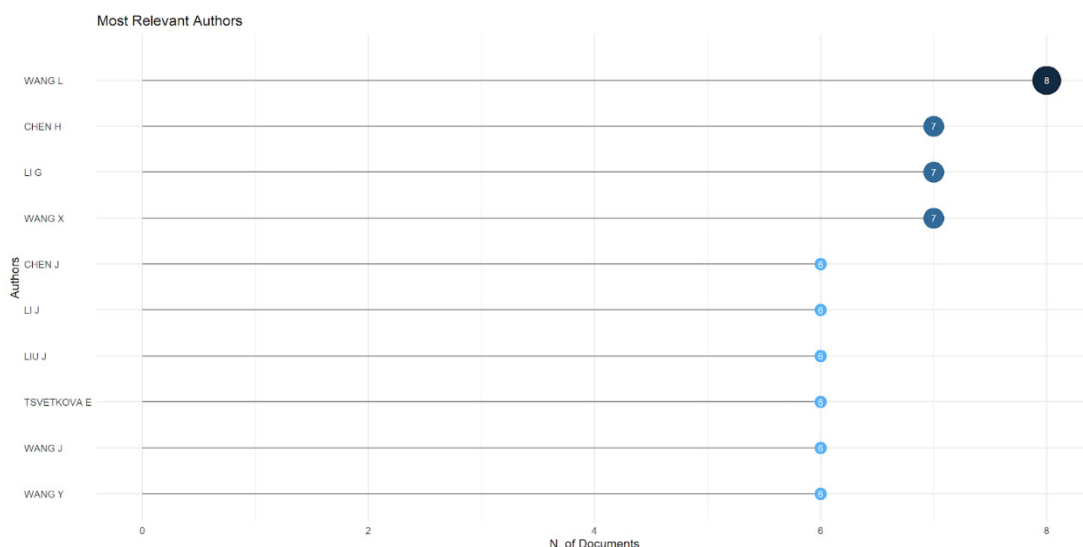

Figure 6. Most Relevant Author

Based on the visualization of the most relevant document feature of biblioshiny software, it shows that the author with the highest number of publications of proceedings articles is Wang L with a total of 8 article publications, then in the second position the author with the 7 most article publications are Chen H, Li G, Wang X. Each author has a different fractionalized article. Article Fractionalized serves to see how much the level of author collaboration between countries in the article. So that the ratio of the most published author, Wang L, has a collaboration ratio with other authors or authors with a value of 1.93 which is still smaller than the ratio of articles written by Tsvetkova E which is 2.83 with a total of 6 documents.

Figure 7. Lotka's Law

Based on the results of document visualization that has been carried out by the biblioshiny application. It was found that every 1 document was written by 1383 authors. This shows that the proportion of authors in the documents written is 0.900%, which is very large compared to the proportion value of one author who wrote 8 documents with a proportion value of 0.001%. The more documents produced, the fewer authors there are. This shows the inequality of productivity among researchers in the field of technological innovation. Only a handful of researchers are responsible for most of the scientific publications on library technology innovation.

Figure 9. Keyword Mapping by VOSViewer

The results of keyword mapping on VOSViewer show that in the first cluster there are keywords related to invasion technology where the most used keyword node is library which is then connected to other keywords. The first cluster explains more about technological innovation which contains the keywords most used by researchers to conduct research on technological innovation in libraries. The second cluster also has a different discussion where the keywords in the second cluster consist of inter-organizational relationships in the library that create library technology innovation. The keywords in the figure make it possible for other studies that will research library technology to search for keywords in data base sources related to technological innovation in libraries. 50% of existing keywords are about technological development innovations in library systems.

Discussion

This study conducted a bibliometric analysis of proceeding paper publications in technological innovation in the library. This analysis includes the most relevant sources, keywords with the highest frequency of occurrence to the co-occurrence network. In addition, this analysis utilizes Web of Science as the main database in data collection with a period of time from 2019 to 2023. From the available data, 433 documents were obtained from 342 sources ranging from journals, books and so on. The documents analyzed are documents in the form of proceeding papers and articles; proceeding papers. This analysis reveals that the keyword that appears most in several documents is the keyword "library" with a percentage of 6%. Not only that, the country that contributes a lot to the publication of proceeding papers in relation to technological innovation in libraries is China, which contributes 131 documents with the main publisher from IEEE (Institute of Electrical and Electronics Engineers).

The research on which this study is based is research conducted by (Khan, Asad Ullah, et al., 2023) who used a scoping literature review with two databases derived from Scopus and Web of Science. The study analyzed a total of 243 documents which included annual publication numbers, the main source of existing publications, as well as countries that have contributed to scientific publications in this research field and also bibliometric analysis. The findings suggest that China is a contributing country that has the most number of publications among other countries, such as the United Kingdom, the United States, and other countries. The period examined in the study also includes trends that are developing in the time period from 2013 to 2023.

In another similar study, conducted by (Wang, Dan, 2023) regarding bibliometric analysis and network mapping of smart libraries showed that the keyword that became the most frequently appearing term was the word from the mobile library. The data in this study were also taken using Web of Science as a database with a time period of 2021 to 2023. Research in this field also shows similarities to China as the country with the most contributions in existing scientific publications. There are various keywords that often appear in this study are related to mobile libraries, digital libraries, libraries, technology, and several other words.

Specifically, research related to bibliometric analysis of technological innovation in libraries, especially in proceeding papers has not been found. However, from similar research in the same field, namely libraries, there are some similarities that exist. Scientific publications on technological innovation in libraries, especially in proceeding papers, have increased from 2019 to 2023.

CONCLUSION

This bibliometric analysis provides an overview of research trends and developments in technological innovation in libraries, based on the publication of papers indexed in Web of Science from 2019 to 2023.

The analysis shows that there has been an increase in research interest in this area, as shown by the increase in the number of publications over the period, with a total of 433 documents published in 342 sources. However, the annual growth rate was negative at -32.33%, indicating a slowdown in publications in recent years.

The most prolific publication sources were the IEEE Winter Conference on Computer Vision Applications and the IEEE Symposium on Security and Privacy. This indicates that these two conferences are key venues for researchers to disseminate their work on technological innovations for libraries. "Library" was found to be the most frequent keyword, appearing in 6% of the documents. Other keywords included "model", "performance",

"system", "design", reflecting the focus on developing and evaluating systems and technology models to improve library services and operations.

The topic trend analysis surfaced keywords such as performance, model, design and library as major themes in technological innovation for libraries. The co-occurrence network also showed the strongest relationship between the keywords "system" and "design", underscoring the research emphasis on system design and development.

Overall, this bibliometric review summarizes the key areas of focus, trends, and leading countries contributing to technological innovation research for libraries over the past five years. The findings provide insights to help guide future research efforts in this domain. Further analysis could examine citation patterns and publication impact to assess the influence of research in this area.

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