

RETRACTED: Emerging technologies and higher education libraries: a bibliometric analysis of the global literature

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Abstract

Purpose – This paper explores emerging technologies in higher education libraries indexed in the Web of Science core collection and Scopus for the periods between 1994 and 2024 (January 18, 2024).

Design/methodology/approach – Data from Web of Science (WoS) and Scopus databases were collected and combined using RStudio software. Once this was completed using RStudio, the combined Scopus and Web of Science Excel file was uploaded into Biblioshiny, an interactive web interface. The data was then categorized to illustrate contributions from authors, journals, countries and academic institutions across the globe.

Findings – Results and findings related to publication growth trends, annual growth, core journals, impact and productivity of authors, most cited documents, collaborations, network mapping and country contributions on emerging technologies and higher education libraries are presented.

Research limitations/implications – This topic requires further exploration as academic librarians are fast becoming integrated into the teaching and learning agenda of institutions globally.

Practical implications – Higher education libraries and library schools to promote the teaching identity of academic librarians by helping them improve their pedagogical and digital skills for online teaching.

Social implications – Library and information science schools need to fast track the integration of emerging technologies into the curriculum. Higher education libraries should consider the training of staff in order to keep abreast of emerging technologies. Library management must frame their policies and strategies in order to promote the use of emerging technologies in higher education libraries.

Originality/value – The current study is novel in that it explores emerging technologies and higher education libraries using combined data from Scopus and Web of Science. The topic of emerging technologies and higher education libraries is still developing and therefore is in its infancy. The research is useful for researchers, library management and library schools in the higher education sector globally.

Keywords Academic libraries, Emerging technologies, Bibliometric analysis, Bibliometrics, Higher education libraries, Scientific mapping

Paper type Literature review

Background and context

Historically, academic libraries have been personified as knowledge centers and information hubs. Evidence of the earliest academic libraries through annals of history are Buddhist Takshshila, Alexandrian and Assyrian (Bevis, 2019). The Buddhist Takshshila was the first university library that pioneered record keeping, storage and archiving. In the ancient world



university libraries were known as producers of knowledge and access points to information. Currently, knowledge production and information access are synonymously aligned to the digital environment vis-à-vis the Internet (Marion and Fixson, 2021). Although designed in the 1980s, the internet became popular during the late 1990s (Sunyaev, 2020). Access to information became seamless and knowledge could be shared instantaneously between libraries and among users through the internet. Thus, the internet transformed university libraries into digital, knowledge and information gateways as society entered the cusp of the new millennium (Olaewe *et al.*, 2019). Recently, changes in university libraries are underscored by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) Sustainable Development Goals (SDGs) (Odonnell and Anderson, 2021).

Globally, Sustainable Development Goals (SDGs) underscore how policies are designed and governed at higher education institutions (Leal Filho *et al.*, 2021). The United Nations Educational, Scientific and Cultural Organisation (UNESCO) underpins SDGs that intend to transform society as outlined in Agenda 2030. These SDGs comprise seventeen objectives that are interlinked and provide a blueprint for public and private enterprises (Abhayawansa *et al.*, 2021). This includes addressing salient issues relating to poverty, inequality, inclusivity, justice and education. Consequently, SDGs also map the strategic goals of higher education institutions to steer teaching, learning and research.

Higher education libraries also develop strategic goals as directed through a university agenda which filters from UNESCO Sustainable Development Goals (Hansen *et al.*, 2021). Although collectively the seventeen goals are interconnected, Farhat and Alaeddine (2023) posit SDG 4 and 10 have carved a distinct path for higher education libraries since universities are streamlining their position based on these goals. Sustainable Development Goals 4 and 10 address issues such as equality, equitable access, inclusivity, quality education, disability, race, ethnicity, religion and socioeconomic status. In their pursuit to align with SDGs 4 and 10, Thorpe and Gunton (2022) state that higher education libraries are exploring how emerging technologies can effectively support diversity to *leave no one behind* aligned with the UNESCO 2030 Agenda.

Twenty-three years into the new millennium, higher education libraries are witnessing a seismic shift due to emerging technologies, notwithstanding the internet (Ashiq *et al.*, 2021; Wang *et al.*, 2023). However, currently, emerging technologies in higher education libraries paint a blurred picture (Moni *et al.*, 2020). According to Bharti and Verma (2021), there are pockets of brilliance associated with emerging technologies and higher education libraries. Juxtaposed, there is a dearth of literature that draws meaningful conclusions as to how impactful emerging technologies have been in higher education libraries (Ashiq and Warraich, 2023; Rafiq *et al.*, 2021). This is noticeable with a trend of buzzwords being used in the literature related to emerging technologies such as *smart services*, *smart technologies* and *smart libraries*. Like the phrase *new norm* which was punted in higher education circles during COVID-19, however, it withered away as institutions returned from a lockdown into a face-to-face learning environment. Not to say the same is happening with higher education libraries, though, in retrospect emerging technologies were only accelerated during the Covid-19 pandemic (Yu *et al.*, 2023a, b). Thus, globally, the literature shows patterns of emerging technologies at higher education libraries with paucity. Moreover, worldwide, the impact of emerging technologies on higher education libraries to support teaching, learning and research is unclear, and not short of challenges (Mohideen *et al.*, 2022).

Emerging technologies in the form of data analytics, machine learning, artificial intelligence, chatbots, gamification, robotics, digital literacy, research data management, assistive technologies, maker space, adaptive spaces, 3D printing, Internet of Things, mobile technology, augmented reality, virtual reality, digital preservation and storage underpinned through the Fourth Industrial Revolution are reimagining higher education libraries (Ajani *et al.*, 2024; Anser *et al.*, 2023; Asemi *et al.*, 2021; Edwards *et al.*, 2022; Gunapala *et al.*, 2020; Wójcik, 2021; Zhou *et al.*, 2022). Information access, information resources, services, facilities

and most importantly human resources are precariously positioned as library management attempts to steer higher education libraries to a place of relevancy and sustainability through cutting-edge emerging technologies (Khan *et al.*, 2023; Ocran and Afful-Arthur, 2022; Shahzad and Khan, 2023). This means for the first-time higher education libraries are navigating uncharted waters and are intensively engaged in dialogues with relevant stakeholders on a global scale. The purpose of such dialogues is to direct a new era in which the role of emerging technologies can be clearly understood and conceptualized across the world at higher education libraries.

Worldwide, higher education libraries are not the only role players involved in such discussions about emerging technologies (Afjal, 2023; Agarwal *et al.*, 2022; Awan and Abbas, 2023; Li and Liu, 2023; Saeidnia *et al.*, 2024). Management, national councils and communities of practice in higher education are also deliberating on how emerging technologies can effectively direct systems and processes (Ai-Jou *et al.*, 2024; Chen, 2023; Ulnicane *et al.*, 2021). The overwhelming reason for such conversations is due to the blurriness related to emerging technologies and higher education institutions (Huang *et al.*, 2022; Sitaridis and Kitsios, 2024; Wang and Xie, 2023). This is justified through the massification of communities of practice that are freely available for anyone to join on social platforms such as LinkedIn and Facebook to learn about emerging technologies (Luo *et al.*, 2020). Staff at all levels at higher education institutions are on a deep learning curve exploring how to integrate emerging technologies in a meaningful way within daily practices. Similarly, higher education libraries are using social platforms to attract a larger audience of experts to engage, learn and share practices related to emerging technologies (Eaton and Pasquini, 2020; Muhammad and Zhiwei, 2021). This can help make well-informed decisions when introducing emerging technologies into library spaces to support the university agenda.

Literature review

Challenges in higher education libraries are centered around cost implications, maintenance, staff development, user support, security and privacy concerns (Clark and Lischer-Katz, 2023; Hamad *et al.*, 2022). In developing economies such as Kenya, and Pakistan challenges are compounded since higher education libraries must balance traditional library services with emerging technologies (Hussain and Ameen, 2023; Otike and Barât, 2021). This presents a complex situation as students enter universities from diverse socio-economic backgrounds in developing economies resulting in equitable service being a daily challenge (Bouaamri *et al.*, 2022). Hence, the library must ensure it meets the needs of users without compromising access to information as underscored in SDGs 4 and 10 either through traditional or emerging technologies. Notwithstanding, the balancing act of traditional vs emerging technologies juxtaposed the current major challenge facing higher education libraries is the ability to create balance between innovation, technology, skilled staff and user needs (Aslam, 2022; Dalili Saleh *et al.*, 2022; Ducas *et al.*, 2020; Kaffashan Kakhki *et al.*, 2022; Loghmani Khozani *et al.*, 2022; Mohideen *et al.*, 2022; Yu *et al.*, 2023a, b).

In a systematic review using Preferred Reporting Items for the Systematic Review and Meta Analysis Methods, Shahzad and Khan (2023), point out the importance of emerging technologies related to the professional development of library staff and e-learning. The study urges university library management to invest in staff development and emerging technologies as this will improve customer-focused services in an online environment. Barriers and limitations to the implementation of emerging technologies in an e-learning environment are also identified in the study. This included poor library leadership, inadequate technological infrastructure and a lack of financial prowess to sustain emerging technologies in an e-learning environment. Therefore, the study recommended incentives for staff that demonstrate effectiveness in e-learning programs, financial allocations to upgrade

technological infrastructure, staff training and development initiatives, regular evaluation and feedback of staff to identify areas of improvement concerning emerging technologies.

Similarly, [Hamad et al. \(2023\)](#) elaborate that rapid advancements in technology have forced academic libraries to reimagine traditional services, facilities and resources by adopting emerging technologies to create a *smart library*. This is driven by the changing information needs of users who are Generation Z students are more technologically inclined. The study shows that emerging technologies can provide effective support in accessing and using information for scholarly purposes as Generation Z users are not limited to physical library spaces. However, there are also challenges such as resistance to change from library staff, financial issues, poor infrastructure and inadequate resources for staff development. This in turn can slow the transformation of higher education libraries into smart libraries using emerging technologies to support Generation Z users.

[Okunlaya et al. \(2022\)](#) used a qualitative content analysis method to interrogate the extant literature on Artificial Intelligence (AI) and its relative adoption in various organizations. Nonetheless, the focus was on how AI can leverage solutions related to service delivery at university libraries as an organization. The aim was to design a conceptual framework that would seamlessly integrate AI applications into library service delivery and generate possible solutions to aid university libraries. Findings underscored robotics, learning analytics, data mining, natural language processing, deep learning, sensors and electronic tags as key AI applications or functions that could drive university libraries into becoming cutting-edge 21st-century environments. Despite the opportunities presented in using AI, the study revealed the dangers of resisting the use of these applications seems to persist in higher education libraries. This places higher education libraries in a very precarious position as history has shown enterprises collapse when there is resistance to change. The recent COVID-19 pandemic is a testament to this, however, there is still time as higher education libraries are still identifying and experimenting with emerging technologies. Thus, higher education libraries need to re-position, re-imagine and take advantage of emerging technologies if they are serious about providing smart library services in the new digital age.

Similar to the findings in [Shahzad and Khan \(2023\)](#), [Hamad et al. \(2023\)](#), [Okunlaya et al. \(2022\)](#), numerous other studies on emerging technologies reveal the changing landscape in higher education libraries across the globe ([Bharti and Verma, 2021](#); [Bouaamri et al., 2022](#); [Cheung et al., 2023a, b](#); [Jiang et al., 2022](#); [Khan et al., 2022](#); [Maceli, 2022](#); [Nadi-Ravandi and Batooli, 2023](#); [Nugroho et al., 2023](#); [Senthil Kumaran and Latha, 2023](#); [Yu et al., 2023a, b](#)). Smart libraries, data mining, AI, robotics, virtual reality, machine learning, data analytics, assistive technologies, research data management, digital preservation, Internet of Things are rigorously being probed in the extant literature *vis-à-vis* higher education libraries and emerging technologies ([Ajami et al., 2024](#); [Hamad et al., 2023](#); [Khan et al., 2023](#); [Yoon et al., 2022](#)). Consequently, emerging technologies is a niche area within higher education libraries that is topical and being explored extensively, worldwide. Therefore, a bibliometric analysis focusing on the tendencies of emerging technologies has significant poise for higher education libraries. Moreover, a bibliometric analysis positions the discussion for scientists to map global trends, leading journals and authors to direct future research on emerging technologies and higher education libraries.

Research method

Bibliometric analysis

Bibliometrics are rigorously applied methods that analyze large amounts of scientific data ([Donthu et al., 2021](#)). It provides scientific direction because it unpacks nuances related to trends and topics that are currently emerging in a specific field. Therefore, the purpose of a bibliometric analysis is to analyze the scientific productivity of a topic within a particular

field. Further, the use of bibliometrics studies to examine the trends and patterns in higher education libraries is not uncommon (Mishra *et al.*, 2022; Siddique *et al.*, 2023; Nugroho *et al.*, 2023). Over recent years there has been an increase in exploring emerging technologies, smart libraries and smart services in higher education libraries using bibliometrics analysis (Wang, 2023). In addition, many questions emanate from a bibliometric study such as a larger number of publications versus trending nature or even whether a topic being explored is serving the research needs of a specific community. However, this study utilizes scientific mapping and performance analysis as the primary techniques for emerging technologies in higher education libraries. The performance analysis technique focused on publication output by country, affiliation, author and growth trends over three decades. In terms of emerging technologies and higher education libraries scientific mapping was used to orchestrate network mapping, co-authorship analysis, co-occurrence network and collaboration network. Thus, it is within this context, our goal was to explore emerging technologies in higher education libraries.

This provides academics and practitioners a clearer understanding of the reliability, validity and impact of a topic using bibliometrics. To answer these types of questions the data needs to be analytically unpacked through an empirical lens. Further, when it is unpacked empirically using measurable standards then it becomes viewable through a transparent researched window. Bibliometric analysis software such as Biblioshiny is used to explore relationships between a topic through empirical data. This allows researchers to draw associations, data trends and make recommendations based on the patterns generated on a topic.

Research questions

- RQ1. What are the global research trends related to emerging technology and higher education libraries between 1994 and 2024?
- RQ2. Which are the leading journals that have actively contributed to emerging technology research in higher education libraries?
- RQ3. Who are the leading authors and which are the countries that have actively contributed to emerging technology research in higher education libraries?
- RQ4. Which are the most cited articles that contribute to the body of knowledge in emerging technology research and higher education libraries?

To initially address these questions, we analyzed 4,345 literature sources relating to emerging technologies and higher education libraries between 1994 and 2024 (January 18, 2024). The methods adopted in this study were two-fold. Firstly, the relevant citation databases were selected, and the search strategies were formulated by the authors. The databases selected are justified through the extant literature and the search strategies used are presented in Table 1. Secondly, the stages of how the data was extracted through the databases and the bibliometric analysis process are discussed as illustrated in Figure 1.

Selected databases and search strategies

Scopus and Web of Science (WoS) are considered the most reputable citation databases for interrogating bibliometric data (Zhu and Liu, 2020; Wang and Si, 2023). In this study, both Scopus and WoS were used to find, process and analyze data on the topic. The study was aimed at higher education libraries and emerging technologies. Therefore, within this context, the term “emerging technolog”^{*} was used as a primary search with related terms

"3D printing" OR 4IR OR "4th industrial revolution" OR "adaptive spaces" OR AI OR "artificial intelligence" OR "assistive technolog*" OR "augmented reality" OR automation OR "big data" OR "biometric authentication" OR chatbots OR chatgpt OR "cloud computing" OR "collaborative learning" OR "collaborative space*" OR "collaborative technolog*" OR "computing technology" OR "data analytics" OR "data mining" OR "data science" OR "deep learning" OR "digital archiving" OR "digital literac*" OR "digital preservation" OR "digital resources" OR "electronic tags" OR "emerging technolog*" OR "facial recognition" OR "fingerprint recognition" OR "futuristic technolog*" OR gaming OR "generative artificial intelligence" OR "innovative technolog*" OR repositor* OR "integrated library system*" OR "Internet of things" OR IOT OR "iris recognition" OR "Learning commons" OR "learning spaces" OR "machine learning" OR makerspace OR "meta literac*" OR "mobile app*" OR "natural language processing" OR "new technolog*" OR "online resource*" OR "online service*" OR "online teaching" OR "open access publishing" OR "open source software" OR podcasting OR "radio frequency identification" OR RDM OR "research commons" OR "Research data management" OR RFID OR robotics OR sensors OR "smart librar*" OR "smart service*" OR "social media" OR "software application*" OR "technology trend*" OR "virtual reality" OR "voice recognition"

AND

"university librar*" OR "academic librar*" OR "college librar*" OR "higher education librar*" OR "tertiary librar*"

Source(s): Table created by authors

Table 1.
Concept one-emerging
technolog* and
related terms

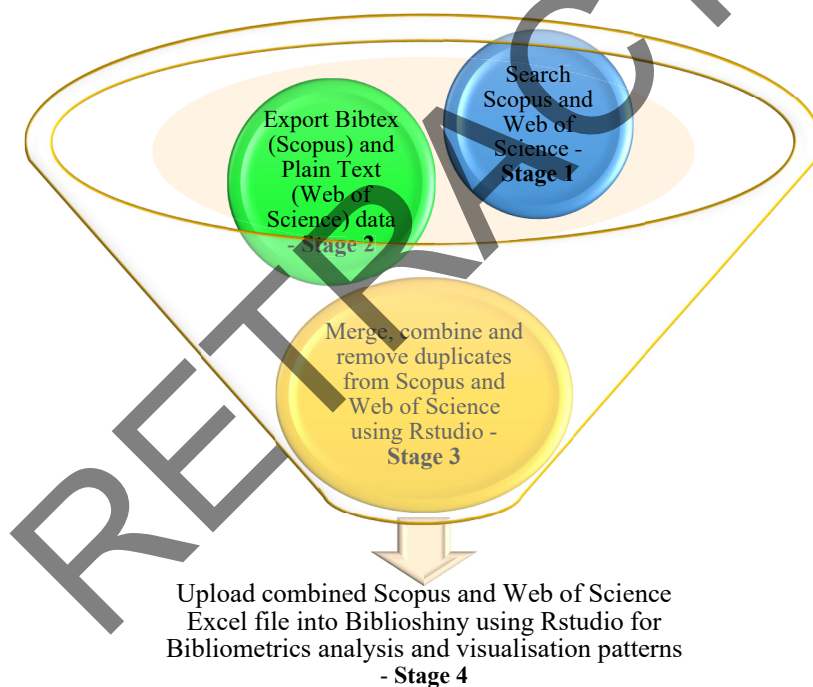


Figure 1.
Merged Scopus and
Web of Science data by
authors

when searching Scopus and WoS. Thereafter, the secondary terms included a string of derivatives that can be used when describing higher education libraries. Further, there were no refinements made to timelines such as using a decade in the search criteria since emerging technologies are a rapidly evolving topic.

In both Scopus and WoS the same criteria were selected when searching the concepts that is- *Article Title, Abstract and Keywords*. However, the one difference is that WoS presents

another criterion within its search string, *Keyword Plus*. This option enhances results by combining words and phrases that occur together through an automated computer algorithm in the titles of an article's references but do not appear in the specific title of the article itself (Kawuki *et al.*, 2021). Table 1 presents the terms used when searching both citation databases. The primary term “emerging technolog*” is combined with related, secondary terms and derivatives to conduct searches and find results.

Merging and mapping the data

The methods used in this study included four stages. In the first stage, search terms were selected, relevant search strategies were used, and the data were extracted from research-intensive citation databases, Scopus and Web of Science. Multiple records were downloaded from Scopus (4,044) in BibTeX format whilst Web of Science records (1,576) were downloaded in sets of not more than 500 as these are the parameters of the database in plain text format - (full recorded and cited references). The Web of Science's comprised three sets of 500 records and the fourth 76 which was combined into a single plain text file. In stage 2, Rstudio a coding software was used to merge and combine Web of Science and Scopus data. During this process, BibTeX (Scopus) and plain text (Web of Science) files were merged, and duplicate records (1,235) were removed using Rstudio. Stage 3 followed, wherein Rstudio was used to save the combined Scopus and Web of Science files into an Excel spreadsheet. It is uncommon that results from different databases are combined for a bibliometrics analysis, especially using Scopus and Web of Science (Echchakoui, 2020). Software packages such as VOSviewer do not combine files from different databases simply because one of the major stumbling blocks is to remove duplicates. However, Rstudio can code BibTeX (Scopus) and plain text (Web of Science) such that duplicates are removed after merging and combining them into one single Excel file for output and analysis. The combined files after removing duplicates consisted of 4,345 documents. Once this was completed using Rstudio, the combined Scopus and Web of Science Excel file was uploaded into Biblioshiny. The data was then categorized and evaluated to illustrate contributions from authors, journals, countries and academic institutions across the globe. Thereafter, Biblioshiny was used for constructing, mapping and visualizing bibliometric networks leading to data being plotted together to provide deep insights into Scopus and WoS via bibliometric visual networks. Thus, Biblioshiny provided an analytical and visual bibliometric perspective on emerging technologies and higher education libraries – stage 4.

Results and findings

Datasets from Scopus and WoS databases were combined between 1994 and 2024 to probe the topic – Figure 1. A total of 4,345 documents were retrieved of which 1,271 were single-authored publications with 1,040 unique journals – Figure 2.

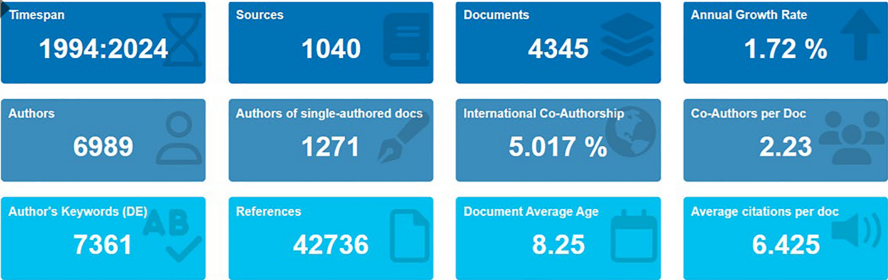


Figure 2.
Overview of the analysis using Biblioshiny, sources combined Scopus and Web of Science data compiled January 18, 2024

Emerging technologies and publication growth trends – (1994–2024)

Figure 3 provides valuable insights into emerging technologies and higher education libraries. In the past three decades trends depict an annual publication growth of 8.25% between 1994 and 2024. This is established when three decades (equally 360 months) are divided by literature sources (4,345) and then multiplied by one hundred (100) showing a constant in the *document average age* publication annually (8.25%) – Figure 2. Two other important trends in Figure 3 are the acceleration points in publications between 2018 and 2021 and slight fluctuations that are evident during certain years. Thus, Figure 3 also seems to indicate that the concept of emerging technologies in higher education libraries could be at a point of gestation as the trend and growth depict a constant increase of 8.28% of publications with fluctuations during certain years between 1994 and 2024. This can be supported by a modest *annual growth rate* of 1.72% related to emerging technologies and higher education libraries worldwide – Figure 2. Interestingly the growth rate concerning emerging technologies and higher education libraries in this study represents a combined dataset extracted from Scopus and WoS as explained in Figure 1. Thus, the quantitative data through the lens of the combined dataset paint a clear picture related to publication growth trends between 1994–2024 on emerging technologies and higher education libraries.

Core journals by Bradford's law

Table 2 presents the core journals in the subject area using Bradford's Law which divides the journals into three zones. The core journals in Zone 1 have the most significant publications. We found that 18 journals (out of 1,040) resided in Zone 1 and the rest of the journals were in Zone 2 and Zone 3.

Source production over time

The top five journal sources present a gradual increase in production between 1994 and 2024 - Figure 4. At the advent of the internet and technology between 1994 and 2004 production in the top five journal sources was moderate. However, as the internet and technology grew in

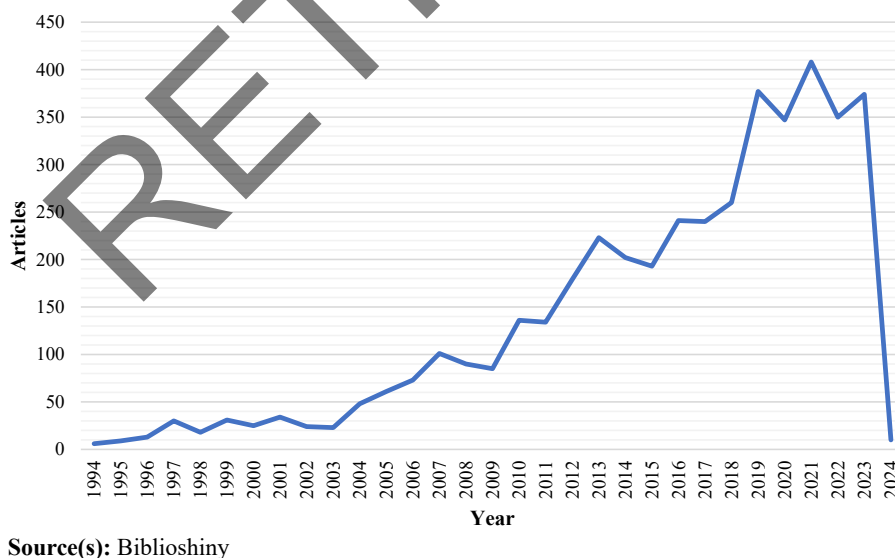


Figure 3.
Annual scientific
production 1994–2004

Table 2.
Top journals based on
Bradford's law

Sources	Rank	cumFreq	Zone
Library Philosophy and Practice	1	226	Zone 1
Journal of Academic Librarianship	2	411	Zone 1
Library Hi Tech	3	545	Zone 1
Electronic Library	4	634	Zone 1
Library Management	5	721	Zone 1
Reference Services Review	6	801	Zone 1
Library Hi Tech News	7	880	Zone 1
New Review of Academic Librarianship	8	949	Zone 1
Journal Of Library Administration	9	1,013	Zone 1
Evidence Based Library and Information Practice	10	1,072	Zone 1
Profesional De La Informacion	11	1,129	Zone 1
Serials Librarian	12	1,183	Zone 1
College and Research Libraries	13	1,235	Zone 1
Digital Library Perspectives	14	1,287	Zone 1
Information Technology and Libraries	15	1,334	Zone 1
Journal of Librarianship and Information Science	16	1,380	Zone 1
New Library World	17	1,426	Zone 1
Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	18	1,465	Zone 1
Library Review	19	1,504	Zone 2
Program-Electronic Library and Information Systems	20	1,543	Zone 2
Public Services Quarterly	21	1,582	Zone 2
College and Undergraduate Libraries	22	1,620	Zone 2
Journal of Web Librarianship	23	1,656	Zone 2
OCLC Systems and Services	24	1,691	Zone 2
Library Trends	25	1720	Zone 2
Source(s): Biblioshiny			

stature the topic of emerging technologies also increased and became relevant to these journals. It is interesting to note that between the years 2018 and 2021 there is an escalation in production within the source- *Library Philosophy and Practice*. However, an acceleration in publications is also prevalent in the *Journal of Academic Librarianship* and *Library Hi Tech*. We assume that escalation trends for these sources increased significantly between the years 2020 and 2022, and a contributing factor could be COVID-19. Additionally, Sustainable Development Goals have also created an urgency to adopt emerging technologies in higher education libraries. This has been detailed under the literature review section by the authors.

Impact and productivity of authors

Table 3 presents the top authors based on the h-index, total citations, number of publications and the year authors began publishing on the topic. The h-index is calculated by the number of publications and citations of an author to quantify the impact and productivity over a period (Poirrier et al., 2021). Within this context, we list the top 25 authors based on their h-index through the period 1994–2024. The most prominent and leading authors are Chiu, Cox, Baro and Lo based on their h-indexes.

Figure 5 plots the number of authors production over time related to emerging technologies and higher education libraries spanning two decades. It shows that most of the prominent authors are experts who have been publishing in this field for over a decade such as Chiu, Cox and Baro. Interestingly results presented in **Figure 5** also align with **Figure 4**, wherein the same two authors who illustrate the highest h-index, total citations and publications are plotted in production over time – Chiu and Cox. Besides these two prominent

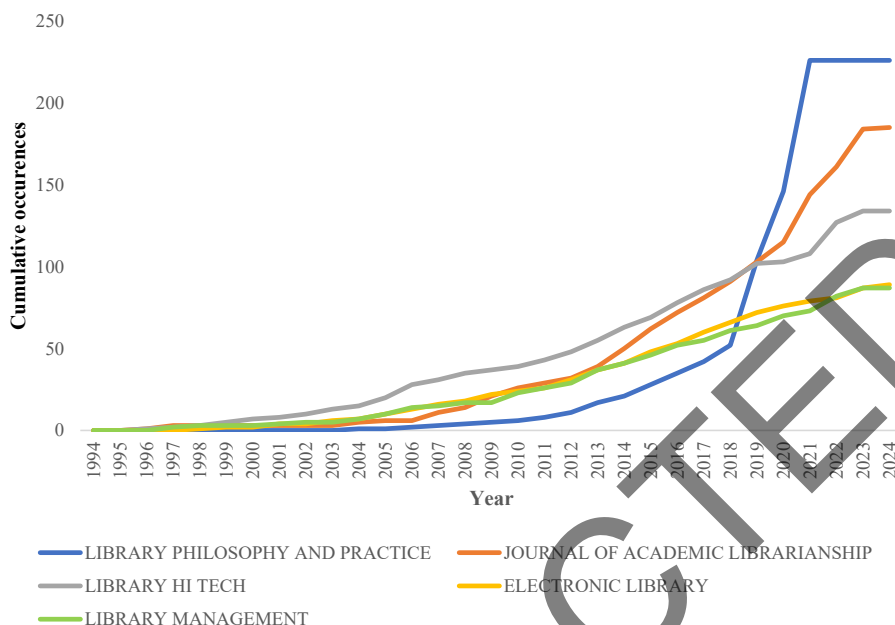


Figure 4.
Top five producing
journals between 1994
and 2024

Source(s): Biblioshiny

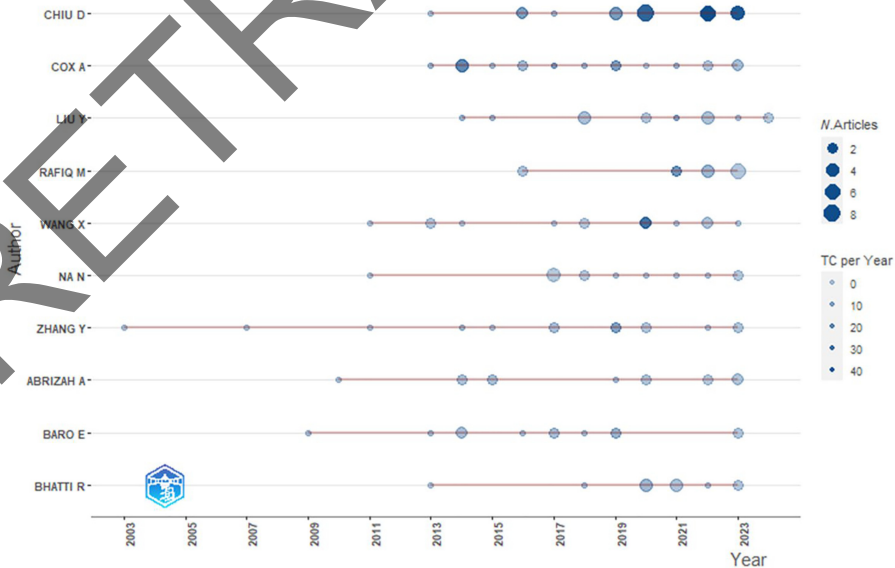
authors, there is one classic expert who has been publishing on the topic since 2003 – (Zhang, Y). Although, the prominent authors had a greater impact their interest in the topic started ten years later compared to Zhang, Y – [Figure 5](#). Further, in recent years there has been one emerging author within the context of the topic – (Rafiq, M). Moreover, Lotka's law was derived from Biblioshiny to explain the publication frequency of authors on the topic. Productivity of authors on the topic as obtained from Lotka's law indicated that 80% made a single contribution during a given period. According to [Miau and Yang \(2018\)](#), the $xny = \text{constant}$ formula in Lotka's law of author productivity narrates the inverse in power. In other words, as the quantity of documents written increases then the number of authors publishing over time decreases. Thus, based on Lotka's law as documents written increased in terms of emerging technologies and higher education libraries the number of authors decreased. Based on Lotka's law, only 12.6 and 3.8% published two and three on the topic as single authors over two decades.

When using bibliometric analysis to explore large amounts of scientific data it is important to establish the most cited documents globally and locally ([Donthu et al., 2021](#)). Global citations refer to documents cited across the length and breadth of the world by scholars within a scientific collection such as WoS and Scopus. On the other hand, local citations indicate which documents have been referenced within the parameters of a scientific collection. In [Figures 6 and 7](#) the authors present most global and local cited documents between 1994 and 2024. There is a moderate tendency wherein documents are both globally and locally cited–Corrall and Tenopir. However, this is not the same in all instances as [Figures 6 and 7](#) reveal that documents can be locally cited, and the inverse could apply to global citations. Globally, three of the highest cited documents within the context of emerging technologies and higher education libraries are authored by Wang, Ford and Beall. In terms of local cited documents, the highest citations were authored by Cox and Tenopir.

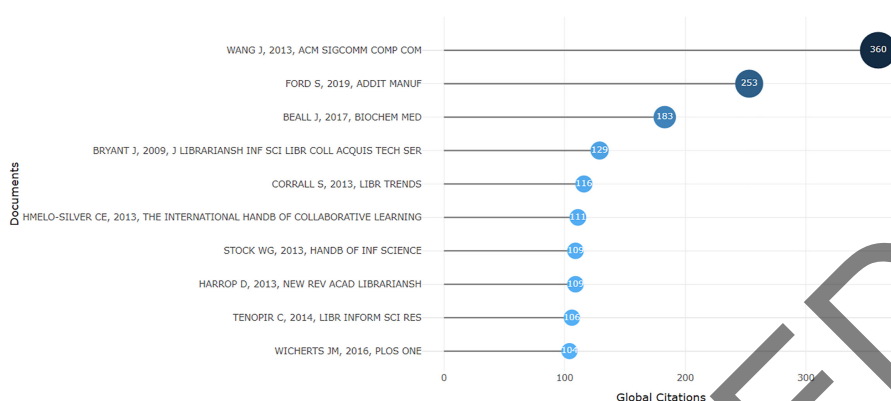
Table 3.
Top authors based on
h-index

Authors	h -index	Total citations	Number of publications	Publication Year_Start
Chiu D	18	629	29	2013
Cox A	13	584	19	2013
Baro E	10	180	13	2009
Lo P	10	240	12	2013
Ho K	8	230	9	2016
Koltay T	7	219	11	2010
Lam E	7	194	7	2019
Mutula S	7	94	13	2001
Pinfield S	7	386	7	2014
Wang Y	7	261	12	2007
Khan A	6	67	10	2013
Abrizah A	5	87	13	2010
Ahmad K	5	81	11	2019
Al-Daihani S	5	92	5	2016
Allard B	5	96	5	2017
Bennett S	5	172	6	2007
Blummer B	5	55	9	2006
Chan D	5	108	7	2005
Groenendyk M	5	95	5	2013
Hamad F	5	68	9	2021
Kennan M	5	314	7	2011
Kenton J	5	53	8	2009
Li Y	5	74	13	2001
Liu Y	5	137	16	2014
Pinto M	5	65	8	2012

Source(s): Biblioshiny



Source(s): Biblioshiny



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Figure 6.
Most global cited documents

Source(s): Biblioshiny

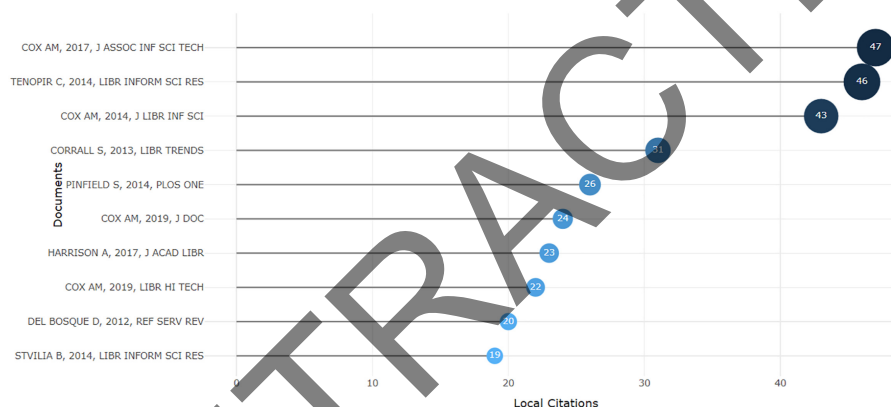


Figure 7.
Most local cited documents

Source(s): Biblioshiny

Countries' scientific production and corresponding authors

Figures 8 and 9 present results on the top 10 countries. However, Figure 8 focuses on the frequency of scientific publications whilst Figure 9 identifies the publication trends between corresponding author countries. The analysis for corresponding author countries in Figure 9 is divided into two categories derived from Biblioshiny – Single Country Publication (SCP) and Multiple Country Publication (MCP). These two categories relate to authors collaborating within a country referred to as “intra”- SCP and “inter”- MCP working together with authors from two or more countries. The ratios of SCP and MCP tend to vary considerably between countries. Figure 9 shows the top ten corresponding author countries related to emerging technologies and higher education in libraries, which are the USA (SCP = 1,037, MCP = 35), China (SCP = 300, MCP = 38), United Kingdom (SCP = 160, MCP = 9) and India (SCP = 150, MCP = 3). This is also followed by other corresponding author countries in the world. It is commendable to note that the top ten corresponding author countries, as illustrated in Figure 9, are the same countries that appear in Figure 8, as the top countries in scientific production on the topic. Thus, Figures 8 and 9 correlate with each other depicting a very important

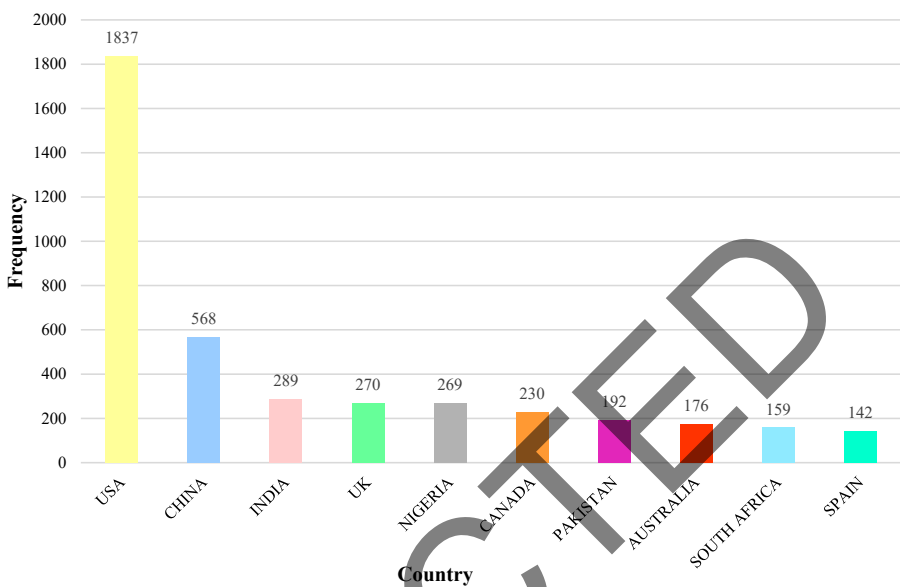


Figure 8.
Top ten countries
scientific production
countries

Source(s): Biblioshiny

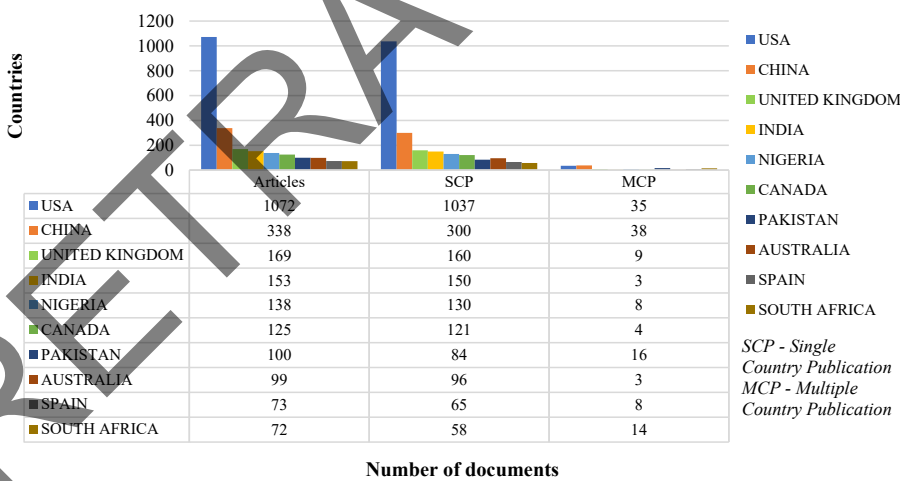


Figure 9.
Top 10 corresponding
author countries

Source(s): Biblioshiny

relationship between the frequency of scientific publications and corresponding author countries in the literature related to emerging technologies and higher education in libraries.

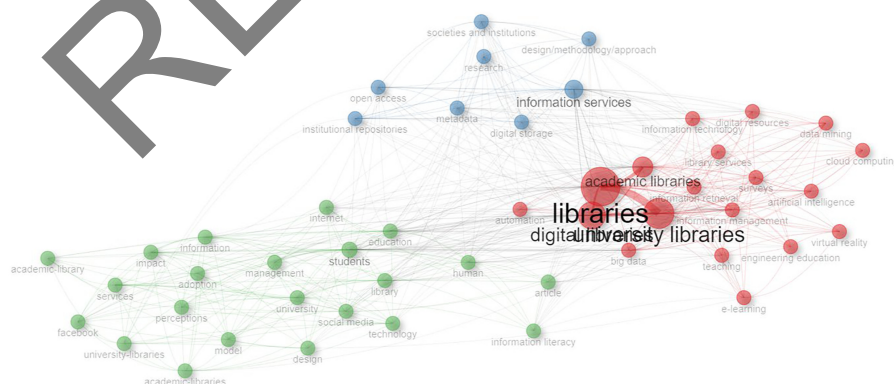
Networking mapping

Network mapping can be used to interrogate results and findings of a bibliometric analysis study. The focus of network mapping is to shed light on research constituents within a topic being explored such as authors, countries and institutions which may not be evident through

citations or publications (Donthu *et al.*, 2021). Biblioshiny, as a web-based bibliometric analysis software, presents rich data through intellectual and conceptual structures using network and thematic approaches. One such network that resides under conceptual structure is the sub-category, co-occurrence network. This provides a detailed understanding of a research topic using keywords plus, authors keywords, titles, abstracts and subject categories (WoS). Within the context of emerging technologies, keywords plus were used to identify the core topics that emerged from the data. Huang *et al.* (2020) concur that keywords can be widely used to identify core topics related to technology in a particular field. Further, co-occurrence networks can be used to illustrate keywords in the form of network maps. There are various clustering algorithms when mapping keywords using co-occurrence networks. For this study, the Louvain clustering algorithm was applied as it is widely accepted as a preferred option (Lancichinetti and Fortunato, 2012). Figure 10 displays a co-occurrence network using the Louvain layout derived from three clusters of networks with *university libraries* and *libraries* as emerging as key terms. However, *digital libraries* are central to interconnecting vertex emerging keywords, *university libraries* and *libraries* in Figure 10. Within the three clusters are three apex keywords which are *digital libraries*, *information services* and *students*. These three apex keywords interconnect terms such as artificial intelligence, data mining, cloud computing, big data, virtual reality, e-learning, digital storage, open access, institutional repositories, social media, Internet and technology within their clusters. It is evident from Figure 10 that keywords connected to apex words within their clusters are in their infancy. This means that these keywords in their clusters can be assumed as emerging technologies within higher education libraries, globally.

Collaboration network

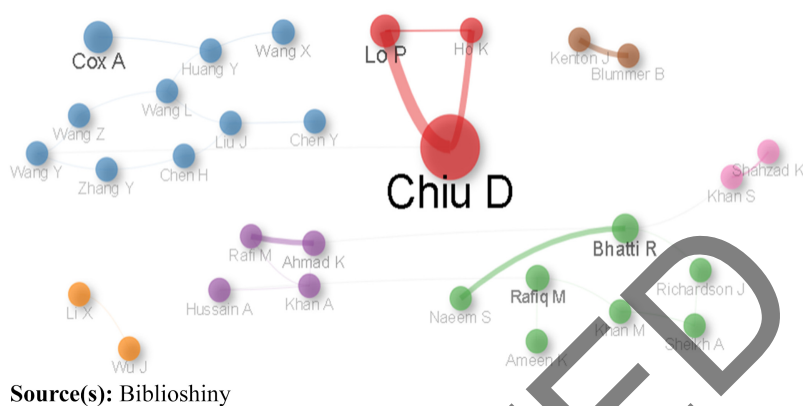
Figure 11 shows that there are seven clusters of authors who have collaborative relationships. Each cluster is represented by a specific color. It can be assumed that authors in the same cluster network often or sometimes collaborate depending on the thickness of the colored line and size of the font—Figure 11. This assumption presented in Figure 11 can be justified by Table 3 and Figure 5, wherein the same cluster network of authors appears in the findings. From this, we see the cohesiveness and correlations of the data. More importantly, the argument of who are the leading authors that make a significant contribution to emerging technologies and higher education libraries, worldwide are postulated from the data in Table 3, Figure 5 and Figure 11.



Source(s): Biblioshiny

Figure 10.
Keyword plus co-occurrence network
(Louvain layout)

Figure 11.
Authors



There were 50 nodes and 44 links in the network mapping of institutions generated from using the collaboration network option on Biblioshiny (Figure 12). The top universities in terms of cluster, betweenness and closeness were the University of South Africa (Brown), University of North Carolina (Red), University of Hong Kong (Purple) and Pennsylvania Commonwealth University (Blue). This implies that these universities illustrate a strong network collaboration within their cluster as displayed in Figure 12. The strong visibility of the colored links between the University of South Africa and the University of Ghana also justifies that there are robust efforts between certain institutions on the topic. Figure 12 also presents certain institutions in much larger font sizes than others in the same cluster. These are the leading institutions within clusters on the topic. When universities in Figure 12 are plotted against Figure 9 which are the top ten corresponding author countries this provides assuredness and clarity that the top universities in Figure 12 are from the same countries in Figure 9. Thus, this confirms which are the leading countries and institutions in emerging technologies and higher education libraries.

Figure 13 shows the collaboration network of countries around the world related to emerging technologies and higher education libraries. The lighter shade of blue indicates country-specific output while the grey illustrates no outputs in terms of publications from those countries. The darker shade of blue implies the most productive country on the topic

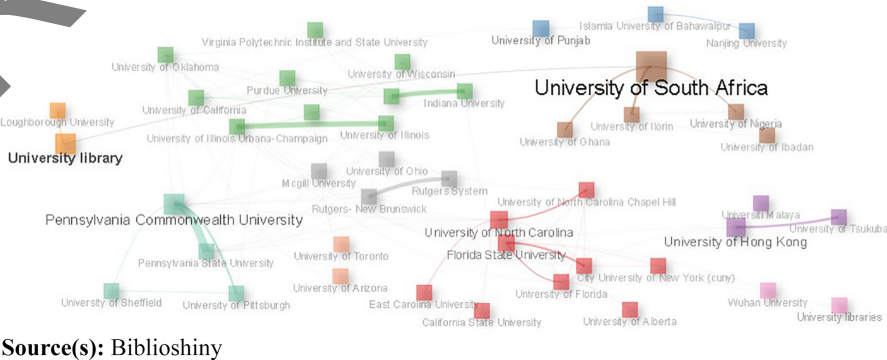
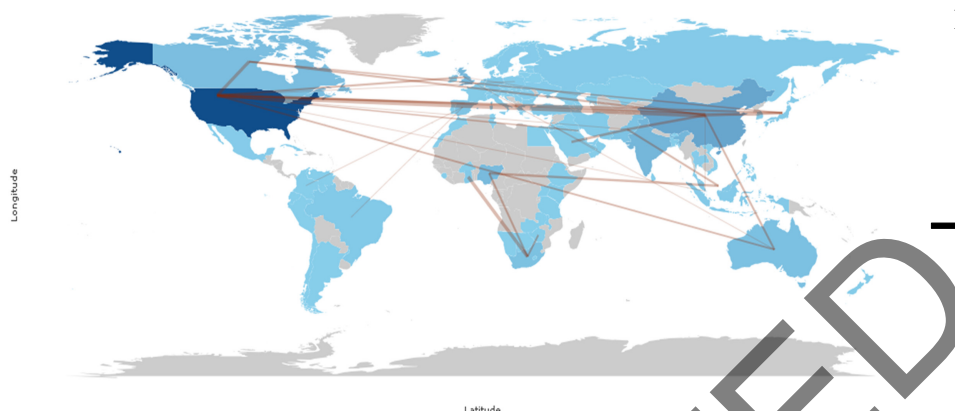


Figure 12.
Institutions



Source(s): Biblioshiny

Figure 13.
Countries

(Farooq, 2022). The brown network lines around the world map specify the collaboration networks of countries that actively publish on the topic. These countries include Canada, Jordan, Nigeria, Pakistan, South Africa, Spain, USA and the United Kingdom. The (1) USA and China has the highest collaborations in emerging technologies and higher education libraries, followed by (2) South Africa and Ghana, then (3) the USA and Canada.

Discussions

In the case of this bibliometric study, the authors peered into emerging technologies and higher education libraries from a quantitative lens over three decades between the years 1994 and 2024. In sum, 4,345 topics on emerging technologies and higher education libraries were published spanning over three decades. There has been a gradual increase from 1994 to 2024 with intermittent blips along the trajectory of the topic as is normal in research. However, it is worth mentioning that between the years 2021 and 2023 publications on the topic spiked. This may be attributed to the plethora of activities using technology during the COVID-19 period. Post-pandemic, emerging technologies are the *buzzword* being used in society just like *new norm* was during the recent pandemic years. The difference is that post-pandemic UNESCO's Sustainable Development Goals have underpinned academic and corporate entities juxtaposed emerging technologies. Nevertheless, in terms of this study, there has been research on the topic, however, still in its infancy.

The authors explored top-ranked journals, top corresponding author countries, most globally cited documents, most prolific authors based on Lotka's law, top authors based on the H-index, core journals based on Bradford's law, top five producing journals, network mapping and collaboration networks. In this study, the top five producing journals are *Library Philosophy and Practice*, *Journal of Academic Librarianship*, *Library Hi-Tech*, *Electronic Library* and *Library Management*. It is noteworthy to mention that the core journals based on Bradford's law – Table 2, correlate with the top five producing journals in Figure 4. This is important for researchers to consider when contributing to the knowledge base on the topic of emerging technologies and higher education libraries.

The USA, China, United Kingdom, India, Nigeria, Canada, Pakistan, Australia, Spain and South Africa were the top corresponding author countries – Figure 9. It is interesting to note that Figure 8 which is labeled “*top ten scientific production countries*” shows that the same countries appear in Figure 9, labeled “*top ten corresponding author countries*”. We note that

the USA, China, India and the United Kingdom were the *top four most productive countries*, simultaneously, these were also the *top four corresponding author countries*. Although the rest of the countries have significantly contributed to the knowledge base it is suggested that they produce more literature on the topic to compete with the top four countries.

Worldwide, literature related to emerging technologies and higher education libraries points to challenges that need addressing (Ashiq *et al.*, 2021; Bharti and Verma, 2021; Bouaamri *et al.*, 2022; Clark and Lischer-Katz, 2023; Otiike and Barát, 2021). Some of these challenges are understanding artificial intelligence, big data, cloud computing, data mining, digital resources, virtual reality, augmented reality, e-learning, 3D printing, digital storage, open access, institutional repositories and how to implement them in a higher education library setting. Furthermore, the literature is explicit in mentioning that such challenges exist due to outdated Library and Information Science curricula, leadership crises, lack of human resources, financial issues, technological problems and limited continuous professional development opportunities (Ashiq *et al.*, 2021; Hamad *et al.*, 2022; Gunapala *et al.*, 2020; Shahzad and Khan, 2023). The findings in this study are intriguing as keywords that are related to emerging technologies and higher education libraries that appear in Figure 10 – *Keyword plus occurrence network* also emerge in the literature. The terms in the bibliometric analysis appear in small font sizes, are sparsely populated from each other, and are between lightly colored network lines. This is an important finding that emerging technologies and higher education libraries are in their infancy as justified through the bibliometric analysis and literature.

The strength of this study is underscored by the scientific data that elucidates transparent correlations across a plateau of findings. One such correlation is evident in Table 3, Figures 5 and 11 wherein authors that appear in Table 3 – *Tops Authors based on the h index*, prominently feature in Figure 5 – *Author Production Over Time (Lotkas Law)* and in the *Collaboration Network of Authors* – Figure 11. This correlation not only validates data reliability but presents the leading scientists concerning emerging technologies and higher education libraries, worldwide. Further, it is interesting to note that scientists such as Chiu, Wang, Zhang, Liu and Rafiq – Table 3, Figures 5 and 11 reside in Asia and the Far East. One can therefore assert that the most prolific and cited researchers in the literature on the topic of emerging technologies and higher education libraries are currently from the Global South.

Scientists from the Global South are charting a path and navigating emerging technologies through collaborations – Figure 11. Pertinent topics such as smart libraries, data mining, AI, robotics, augmented reality, machine learning, data analytics, assistive technologies, biometrics, blockchain technology, cloud computing, research data management, digital preservation, Internet of Things, mobile libraries, social media, maker-space, virtual services, robotics, chatbots, digital library marketing are being addressed in the literature frequently through scientists from the Global South (Cheng *et al.*, 2020; Cheung *et al.*, 2023a, b; Hui *et al.*, 2023; Lam *et al.*, 2023; Lin *et al.*, 2022; Tsang and Chiu, 2022; Yip *et al.*, 2021; Zhou *et al.*, 2022). Moreover, Figure 9 justifies this as Multiple Country Publication shows China as the leading country on emerging technologies and higher education libraries. This is also evident in Author Collaboration – Figures 9 and 11 in which Cox a leading author from the Global North has engaged with academicians from the Global South to publish on the topic. Further, reviewed literature affirms the findings presented in Figures 9 and 11, wherein, emerging technologies such as artificial intelligence, ChatGPT, digital writing, virtual services and research data management in higher education libraries are explored by Cox and academicians from the Global South (Huang *et al.*, 2021, 2023; Li and Cox, 2021; Singh *et al.*, 2023; Zhao *et al.*, 2023, 2024).

Limitations

This study was limited to emerging technologies in higher education libraries. Currently, libraries at higher education institutions have limited resources and therefore require the

support of university management to develop and adopt emerging technologies. A recommendation is to broaden the scope of the topic beyond libraries to explore emerging technologies in higher education institutions. Globally, this will provide university management with an overall perspective of emerging technologies and their value in improving systems and processes at universities.

Conclusions

The study provides a comprehensive overview and an insightful analysis of emerging technologies in higher education libraries using data from Scopus and WOS. Indeed, it is rare to combine results from Scopus and WOS to understand trends through a bibliometric analysis. Hence, this bibliometric analysis is well-positioned to assist researchers in identifying the leading scholars, journals, countries, citations, institutions and collaborations, globally. Earlier, the authors pinpointed the blurriness in the literature related to emerging technologies and higher education institutions. However, this study removes the blurriness and provides clarity to guide researchers in future discussions within the boundaries of higher education libraries and emerging technologies. Ultimately, this bibliometric analysis aimed to create a context for prospective researchers exploring topics within emerging technologies relevant to higher education libraries.

References

- Abhayawansa, S., Adams, C.A. and Neesham, C. (2021), "Accountability and governance in pursuit of Sustainable Development Goals: conceptualising how governments create value", *Accounting, Auditing and Accountability Journal*, Vol. 34 No. 4, pp. 923-945, doi: [10.1108/aaaj-07-2020-4667](https://doi.org/10.1108/aaaj-07-2020-4667).
- Afjal, M. (2023), "ChatGPT and the AI revolution: a comprehensive investigation of its multidimensional impact and potential", *Library Hi Tech*, Vol. ahead-of-print, doi: [10.1108/LHT-07-2023-0322](https://doi.org/10.1108/LHT-07-2023-0322).
- Agarwal, S., Agarwal, B. and Gupta, R. (2022), "Chatbots and virtual assistants: a bibliometric analysis", *Library Hi Tech*, Vol. 40 No. 4, pp. 1013-1030, doi: [10.1108/lht-09-2021-0330](https://doi.org/10.1108/lht-09-2021-0330).
- Ai-Jou, P., Cheng, B.-Y., Chou, P.-N. and Geng, Y. (2024), "Using augmented reality games to support sustainable development goal learning among young students: a true-experimental study", *Library Hi Tech*, Vol. ahead-of-print, doi: [10.1108/LHT-10-2023-0511](https://doi.org/10.1108/LHT-10-2023-0511).
- Ajani, Y.A., Ahmed, A.O. and Muhammed, R.B. (2024), "The illusion of reality in the gaming world: implications for libraries", *Library Hi Tech News*, Vol. 41 No. 2, pp. 1-5, doi: [10.1108/lhtn-06-2023-0099](https://doi.org/10.1108/lhtn-06-2023-0099).
- Anser, M.K., Tabash, M.I., Nassani, A.A., Aldakhil, A.M. and Yousaf, Z. (2023), "Toward the e-loyalty of digital library users: investigating the role of e-service quality and e-trust in digital economy", *Library Hi Tech*, Vol. 41 No. 4, pp. 1006-1021, doi: [10.1108/lht-07-2020-0165](https://doi.org/10.1108/lht-07-2020-0165).
- Asemi, A., Ko, A. and Nowkarizi, M. (2021), "Intelligent libraries: a review on expert systems, artificial intelligence, and robot", *Library Hi Tech*, Vol. 39 No. 2, pp. 412-434, doi: [10.1108/lht-02-2020-0038](https://doi.org/10.1108/lht-02-2020-0038).
- Ashiq, M. and Warraich, N.F. (2023), "A systematized review on data librarianship literature: current services, challenges, skills, and motivational factors", *Journal of Librarianship and Information Science*, Vol. 55 No. 2, pp. 414-433, doi: [10.1177/09610006221083675](https://doi.org/10.1177/09610006221083675).
- Ashiq, M., Rehman, S.U. and Mujtaba, G. (2021), "Future challenges and emerging role of academic libraries in Pakistan: a phenomenology approach", *Information Development*, Vol. 37 No. 1, pp. 158-173, doi: [10.1177/0266666919897410](https://doi.org/10.1177/0266666919897410).
- Aslam, M. (2022), "Changing behavior of academic libraries and role of library professionals", *Information Discovery and Delivery*, Vol. 50 No. 1, pp. 54-63, doi: [10.1108/idd-05-2020-0048](https://doi.org/10.1108/idd-05-2020-0048).

- Awan, W.A. and Abbas, A. (2023), "Mapping the quantity, quality and structural indicators of Asian (48 countries and 3 territories) research productivity on cloud computing", *Library Hi Tech*, Vol. 41 No. 2, pp. 309-332, doi: [10.1108/lht-07-2021-0233](https://doi.org/10.1108/lht-07-2021-0233).
- Bevis, T.B. (2019), "Introduction/learning migration in antiquity", in *A World History of Higher Education Exchange*, Palgrave Macmillan, Cham, doi: [10.1007/978-3-030-12434-2_1](https://doi.org/10.1007/978-3-030-12434-2_1).
- Bharti, K.L. and Verma, S. (2021), "Use of emerging technologies in the university libraries: a study of review of literature", *Library Philosophy and Practice*, pp. 1-22.
- Bouaamri, A., Otiike, F. and Barat, A.H. (2022), "Libraries and library professions in Africa, in confront of the emerging trends and challenges", *The Reference Librarian*, Vol. 63 No. 4, pp. 163-179, doi: [10.1080/02763877.2022.2147677](https://doi.org/10.1080/02763877.2022.2147677).
- Chen, Z. (2023), "Analyzing legal education mobile learner's behavior using deep learning under social media", *Library Hi Tech*, Vol. 41 No. 5, pp. 1298-1316, doi: [10.1108/lht-10-2021-0355](https://doi.org/10.1108/lht-10-2021-0355).
- Cheng, W.W.H., Lam, E.T.H. and Chiu, D.K.W. (2020), "Social media as a platform in academic library marketing: a comparative study", *The Journal of Academic Librarianship*, Vol. 46 No. 5, 102188, doi: [10.1016/j.jacalib.2020.102188](https://doi.org/10.1016/j.jacalib.2020.102188).
- Cheung, C.Y., Lam, A.H.C. and Chiu, D.K.W. (2023a), "Assessing user satisfaction of makerspace in academic libraries: a comparative study based on the 5E instructional model", in Chiu, D.K.W. and Ho, K.K.W. (Eds), *Emerging Technology-Based Services and Systems in Libraries, Educational Institutions, and Non-profit Organizations*, IGI Global, doi: [10.4018/978-1-6684-8671-9.ch009](https://doi.org/10.4018/978-1-6684-8671-9.ch009).
- Cheung, H.C., Lo, Y.Y.M., Chiu, D.K.W. and Kong, E.W.S. (2023b), "Development of smart academic library services with Internet of Things technology: a qualitative study in Hong Kong", *Library Hi Tech*, Vol. ahead-of-print, doi: [10.1108/LHT-06-2023-0219](https://doi.org/10.1108/LHT-06-2023-0219).
- Clark, J.L. and Lischer-Katz, Z. (2023), "(In)accessibility and the technocratic library: addressing institutional failures in library adoption of emerging technologies", *First Monday*, Vol. 28 Nos 1/2, pp. 1-13, doi: [10.5210/fm.v28i1.12928](https://doi.org/10.5210/fm.v28i1.12928).
- Dalili Saleh, M., Salami, M., Soheili, F. and Ziaei, S. (2022), "Augmented reality technology in the libraries of universities of medical sciences: identifying the application, advantages and challenges and presenting a model", *Library Hi Tech*, Vol. 40 No. 6, pp. 1782-1795, doi: [10.1108/lht-01-2021-0033](https://doi.org/10.1108/lht-01-2021-0033).
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N. and Lim, W.M. (2021), "How to conduct a bibliometric analysis: an overview and guidelines", *Journal of Business Research*, Vol. 133 No. 133, pp. 285-296, doi: [10.1016/j.jbusres.2021.04.070](https://doi.org/10.1016/j.jbusres.2021.04.070).
- Ducas, A., Michaud-Oystryk, N. and Speare, M. (2020), "Reinventing ourselves: new and emerging roles of academic librarians in Canadian research-intensive universities", *College and Research Libraries*, Vol. 81 No. 1, pp. 43-64, doi: [10.5860/crl.81.1.43](https://doi.org/10.5860/crl.81.1.43).
- Eaton, P.W. and Pasquini, L.A. (2020), "Networked practices in higher education: a netnography of the #AcAdv chat community", *The Internet and Higher Education*, Vol. 45, pp. 1-10, doi: [10.1016/j.iheduc.2019.100723](https://doi.org/10.1016/j.iheduc.2019.100723).
- Echchakoui, S. (2020), "Why and how to merge Scopus and Web of Science during bibliometric analysis: the case of sales force literature from 1912 to 2019", *Journal of Marketing Analytics*, Vol. 8 No. 3, pp. 165-184, doi: [10.1057/s41270-020-00081-9](https://doi.org/10.1057/s41270-020-00081-9).
- Edwards, A., Edwards, C., Abendschein, B., Espinosa, J., Scherger, J. and Vander Meer, P. (2022), "Using robot animal companions in the academic library to mitigate student stress", *Library Hi Tech*, Vol. 40 No. 4, pp. 878-893, doi: [10.1108/lht-07-2020-0148](https://doi.org/10.1108/lht-07-2020-0148).
- Farhat, B.I. and Alaeddine, H.O. (2023), "Improving assessment criteria of universal design: towards an equitable approach", *MSA Engineering Journal*, Vol. 2 No. 3, pp. 132-167, doi: [10.21608/msaeng.2023.309316](https://doi.org/10.21608/msaeng.2023.309316).
- Farooq, R. (2022), "A review of knowledge management research in the past three decades: a bibliometric analysis", *VINE Journal of Information and Knowledge Management Systems*, Vol. 54 No. 2, pp. 1-40, doi: [10.1108/VJIKMS-08-2021-0169](https://doi.org/10.1108/VJIKMS-08-2021-0169).

- Gunapala, M., Montague, A., Reynolds, S. and Vo-Tran, H. (2020), "Managing change in university libraries in the 21st century: an Australian perspective", *Journal of the Australian Library and Information Association*, Vol. 69 No. 2, pp. 191-214, doi: [10.1080/24750158.2020.1756598](https://doi.org/10.1080/24750158.2020.1756598).
- Hamad, F., Fakhuri, H. and Abdel Jabbar, S. (2022), "Big data opportunities and challenges for analytics strategies in Jordanian academic libraries", *New Review of Academic Librarianship*, Vol. 28 No. 1, pp. 37-60, doi: [10.1080/13614533.2020.1764071](https://doi.org/10.1080/13614533.2020.1764071).
- Hamad, F., Al-Fadel, M. and Fakhouri, H. (2023), "The provision of smart service at academic libraries and associated challenges", *Journal of Librarianship and Information Science*, Vol. 55 No. 4, pp. 960-971, doi: [10.1177/09610006221114173](https://doi.org/10.1177/09610006221114173).
- Hansen, B., Stiling, P. and Uy, W.F. (2021), "Innovations and challenges in SDG integration and reporting in higher education: a case study from the University of South Florida", *International Journal of Sustainability in Higher Education*, Vol. 22 No. 5, pp. 1002-1021, doi: [10.1108/ijsh-08-2020-0310](https://doi.org/10.1108/ijsh-08-2020-0310).
- Huang, C., Yang, C., Wang, S., Wu, W., Su, J. and Liang, C. (2020), "Evolution of topics in education research: a systematic review using bibliometric analysis", *Educational Review*, Vol. 72 No. 3, pp. 281-297, doi: [10.1080/00131911.2019.1566212](https://doi.org/10.1080/00131911.2019.1566212).
- Huang, Y., Cox, A.M. and Sbaffi, L. (2021), "Research data management policy and practice in Chinese university libraries", *Journal of the Association for Information Science and Technology*, Vol. 72 No. 4, pp. 493-506, doi: [10.1002/asi.24413](https://doi.org/10.1002/asi.24413).
- Huang, J., Matthews, K.E. and Lodge, J.M. (2022), "The university doesn't care about the impact it is having on us: academic experiences of the institutionalisation of blended learning", *Higher Education Research and Development*, Vol. 41 No. 5, pp. 1557-1571, doi: [10.1080/07294360.2021.1915965](https://doi.org/10.1080/07294360.2021.1915965).
- Huang, Y., Cox, A.M. and Cox, J. (2023), "Artificial Intelligence in academic library strategy in the United Kingdom and the Mainland of China", *The Journal of Academic Librarianship*, Vol. 49 No. 6, 102772, doi: [10.1016/j.acalib.2023.102772](https://doi.org/10.1016/j.acalib.2023.102772).
- Hui, S.C., Kwok, M.Y., Kong, E.W.S. and Chiu, D.K.W. (2023), "Information security and technical issues of cloud storage services: a qualitative study on university students in Hong Kong", *Library Hi Tech*, Vol. ahead-of-print, doi: [10.1108/LHT-11-2022-0533](https://doi.org/10.1108/LHT-11-2022-0533).
- Hussain, M. and Ameen, L. (2023), "Exploring the automation landscape in university libraries of Khyber Pakhtunkhwa, Pakistan: status, problems and implications", *The Journal of Academic Librarianship*, Vol. 49 No. 6, pp. 1-8, doi: [10.1016/j.acalib.2023.102787](https://doi.org/10.1016/j.acalib.2023.102787).
- Jiang, T., Luo, G., Wang, Z. and Yu, W. (2022), "Research into influencing factors in user experiences of university mobile libraries based on mobile learning mode", *Library Hi Tech*, Vol. 42 No. 2, pp. 564-579, Vol. ahead-of-print, doi: [10.1108/LHT-11-2021-0423](https://doi.org/10.1108/LHT-11-2021-0423).
- Kaffashan Kakhki, M., Zargi, M., Harati, H., Asemandoreh, Y. and Namdar Joyame, E. (2022), "Innovation in using IT: understanding the impact of knowledge absorptive capacity on academic librarians", *Library Hi Tech*, Vol. 40 No. 6, pp. 1843-1868, doi: [10.1108/lht-03-2020-0065](https://doi.org/10.1108/lht-03-2020-0065).
- Kawuki, J., Ghimire, U., Papabathini, S.S., Obore, N. and Musa, T.H. (2021), "A bibliometric analysis of childhood obesity research from China indexed in Web of Science", *Journal of Public Health and Emergency*, Vol. 5, p. 3, doi: [10.21037/jphe-20-95](https://doi.org/10.21037/jphe-20-95).
- Khan, A.U., Zhang, Z., Chohan, S.R. and Rafique, W. (2022), "Factors fostering the success of IoT services in academic libraries: a study built to enhance the library performance", *Library Hi Tech*, Vol. 40 No. 6, pp. 1976-1995, doi: [10.1108/lht-06-2021-0179](https://doi.org/10.1108/lht-06-2021-0179).
- Khan, A.U., Ma, Z., Li, M., Zhi, L., Hu, W. and Yang, X. (2023), "From traditional to emerging technologies in supporting smart libraries. A bibliometric and thematic approach from 2013 to 2022", *Library Hi Tech*, Vol. ahead-of-print, doi: [10.1108/LHT-07-2023-0280](https://doi.org/10.1108/LHT-07-2023-0280).
- Lam, A.H.C., Ho, K.K.W. and Chiu, D.K.W. (2023), "Instagram for student learning and library promotions: a quantitative study using the 5E Instructional Model", *Aslib Journal of Information Management*, Vol. 75 No. 1, pp. 112-130, doi: [10.1108/ajim-12-2021-0389](https://doi.org/10.1108/ajim-12-2021-0389).
- Lancichinetti, A. and Fortunato, S. (2012), "Consensus clustering in complex networks", *Scientific Reports*, Vol. 2 No. 1, pp. 1-7, doi: [10.1038/srep00336](https://doi.org/10.1038/srep00336).

- Leal Filho, W., Salvia, A.L., Frankenberger, F., Akib, N.A.M., Sen, S.K., Sivapalan, S., Novo-Corti, I., Venkatesan, M. and Emblen-Perry, K. (2021), "Governance and sustainable development at higher education institutions", *Environment, Development and Sustainability*, Vol. 23 No. 4, pp. 6002-6020, doi: [10.1007/s10668-020-00859-y](https://doi.org/10.1007/s10668-020-00859-y).
- Li, X. and Cox, A. (2021), "A distinct type of online group for customer knowledge innovation: the virtual product user community", *Libri*, Vol. 71 No. 2, pp. 203-218, doi: [10.1515/libri-2020-0138](https://doi.org/10.1515/libri-2020-0138).
- Li, M. and Liu, L. (2023), "Students' perceptions of augmented reality integrated into a mobile learning environment", *Library Hi Tech*, Vol. 41 No. 5, pp. 1498-1523, doi: [10.1108/lht-10-2021-0345](https://doi.org/10.1108/lht-10-2021-0345).
- Lin, C.-H., Chiu, D.K.W. and Lam, K.T. (2022), "Hong Kong academic librarians' attitudes toward robotic process automation", *Library Hi Tech*, Vol. 42 No. 3, pp. 991-1014, Vol. ahead-of-print, doi: [10.1108/LHT-03-2022-0141](https://doi.org/10.1108/LHT-03-2022-0141).
- Loghmani Khozani, M., Behzadi, H., Nowkarizi, M. and Shafiee Neizar, F. (2022), "We live in cloud computing world, without using it in our libraries", *Library Hi Tech*, Vol. 40 No. 6, pp. 1916-1929, doi: [10.1108/lht-03-2021-0107](https://doi.org/10.1108/lht-03-2021-0107).
- Luo, T., Freeman, C. and Stefaniak, J. (2020), "Like, comment, and share—professional development through social media in higher education: a systematic review", *Educational Technology Research and Development*, Vol. 68 No. 4, pp. 1659-1683, doi: [10.1007/s11423-020-09790-5](https://doi.org/10.1007/s11423-020-09790-5).
- Maceli, M.G. (2022), "Tinkering is underrated: librarians' use of single-board computers and microcontrollers outside of makerspaces", *Library Hi Tech*, Vol. 42 No. 3, pp. 749-764, doi: [10.1108/LHT-11-2021-0378](https://doi.org/10.1108/LHT-11-2021-0378).
- Marion, T.J. and Fixson, S.K. (2021), "The transformation of the innovation process: how Digital tools are changing work, collaboration, and organizations in new product development", *Journal of Product Innovation Management*, Vol. 38 No. 1, pp. 192-215, doi: [10.1111/jpim.12547](https://doi.org/10.1111/jpim.12547).
- Miau, S. and Yang, J.-M. (2018), "Bibliometrics-based evaluation of the blockchain research trend: 2008–March 2017", *Technology Analysis and Strategic Management*, Vol. 30 No. 9, pp. 1029-1045, doi: [10.1080/09537325.2018.1434138](https://doi.org/10.1080/09537325.2018.1434138).
- Mishra, M., Dash, M.K., Sudarsan, D., Santos, C.A.G., Mishra, S.K., Kar, D., Bhat, I.A., Panda, B.K., Sethy, M. and da Silva, R.M. (2022), "Assessment of trend and current pattern of open educational resources: a bibliometric analysis", *The Journal of Academic Librarianship*, Vol. 48 No. 3, pp. 1-12, doi: [10.1016/j.jacalib.2022.102520](https://doi.org/10.1016/j.jacalib.2022.102520).
- Mohideen, Z.A., Sheikh, A., Kaur, K. and Sukmawati, M. (2022), "Fourth industrial revolution (4IR): librarians' perceptions encompass the art of thinking skill", *Library Management*, Vol. 43 Nos 8-9, pp. 521-535, doi: [10.1108/lm-06-2022-0055](https://doi.org/10.1108/lm-06-2022-0055).
- Moni, S.M., Mahmud, R., High, K. and Carbajales-Dale, M. (2020), "Life cycle assessment of emerging technologies: a review", *Journal of Industrial Ecology*, Vol. 24 No. 1, pp. 52-63, doi: [10.1111/jiec.12965](https://doi.org/10.1111/jiec.12965).
- Muhammad, A. and Zhiwei, T. (2021), "Social media and library marketing", *Library Hi Tech News*, Vol. 38 No. 10, pp. 10-13, doi: [10.1108/lhtn-09-2021-0056](https://doi.org/10.1108/lhtn-09-2021-0056).
- Nadi-Ravandi, S. and Batooli, Z. (2023), "Libraries respond to the COVID-19 pandemic: drawing a science map of published articles", *Library Hi Tech*, Vol. 41 No. 1, pp. 42-58, doi: [10.1108/lht-04-2022-0209](https://doi.org/10.1108/lht-04-2022-0209).
- Nugroho, P.A., Anna, N.E.V. and Ismail, N. (2023), "The shift in research trends related to artificial intelligence in library repositories during the coronavirus pandemic", *Library Hi Tech*, pp. 1-16, doi: [10.1108/lht-07-2022-0326](https://doi.org/10.1108/lht-07-2022-0326).
- Ocran, T.K. and Afful-Arthur, P. (2022), "The role of digital scholarship in academic libraries, the case of university of cape coast: opportunities and challenges", *Library Hi Tech*, Vol. 40 No. 6, pp. 1642-1657, doi: [10.1108/lht-09-2020-0238](https://doi.org/10.1108/lht-09-2020-0238).
- O'Donnell, P. and Anderson, L. (2021), "The university library: places for possibility", *New Review of Academic Librarianship*, Vol. 28 No. 3, pp. 232-255, doi: [10.1080/13614533.2021.1906718](https://doi.org/10.1080/13614533.2021.1906718).
- Okunlaya, R.O., Syed Abdullah, N. and Alias, R.A. (2022), "Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education", *Library Hi Tech*, Vol. 40 No. 6, pp. 1869-1892, doi: [10.1108/lht-07-2021-0242](https://doi.org/10.1108/lht-07-2021-0242).

- Olaewe, O., Akinoso, S.O. and Achanso, A.S. (2019), "Electronic library and other internet resources in universities as allied forces in global research work and intellectual emancipation", *Journal of Emerging Trends in Educational Research and Policy Studies*, Vol. 10 No. 1, pp. 41-46.
- Otiike, F. and Barát, Á.H. (2021), "Roles and emerging trends of academic libraries in Kenya", *Library Hi Tech News*, Vol. 38 No. 7, pp. 19-23, doi: [10.1108/lhtn-09-2021-0058](https://doi.org/10.1108/lhtn-09-2021-0058).
- Poirrier, M., Moreno, S. and Huerta-Cánepa, G. (2021), "Robust h-index", *Scientometrics*, Vol. 126 No. 3, pp. 1969-1981, doi: [10.1007/s11192-020-03857-z](https://doi.org/10.1007/s11192-020-03857-z).
- Rafiq, M., Batool, S.H., Ali, A.F. and Ullah, M. (2021), "University libraries response to COVID-19 pandemic: a developing country perspective", *The Journal of Academic Librarianship*, Vol. 47 No. 1, pp. 1-10, doi: [10.1016/j.acalib.2020.102280](https://doi.org/10.1016/j.acalib.2020.102280).
- Saeidnia, H.R., Hosseini, E., Abdoli, S. and Ausloos, M. (2024), "Unleashing the power of AI: a systematic review of cutting-edge techniques in AI-enhanced scientometrics, webometrics and bibliometrics", *Library Hi Tech*, Vol. ahead-of-print, doi: [10.1108/LHT-10-2023-0514](https://doi.org/10.1108/LHT-10-2023-0514).
- Senthil Kumaran, V. and Latha, R. (2023), "Towards personal learning environment by enhancing adaptive access to digital library using ontology-supported collaborative filtering", *Library Hi Tech*, Vol. 41 No. 6, pp. 1658-1675, doi: [10.1108/lht-12-2021-0433](https://doi.org/10.1108/lht-12-2021-0433).
- Shahzad, K. and Khan, S.A. (2023), "Effects of e-learning technologies on university librarians and libraries: a systematic literature review", *The Electronic Library*, Vol. 41 No. 4, pp. 528-554, doi: [10.1108/el-04-2023-0076](https://doi.org/10.1108/el-04-2023-0076).
- Siddique, N., Ur Rehman, S., Ahmad, S., Abbas, A. and Khan, M.A. (2023), "Library and information science research in the Arab World: a bibliometric analysis 1951-2021", *Global Knowledge, Memory and Communication*, Vol. 72 Nos 1/2, pp. 138-159, doi: [10.1108/gkmc-06-2021-0103](https://doi.org/10.1108/gkmc-06-2021-0103).
- Singh, V., Bilal, D., Cox, A., Chidziwisano, G.H. and Dinneen, J.D. (2023), "Global AI initiatives: from theory to practice", *Proceedings of the Association for Information Science and Technology*, Vol. 60 No 1, pp. 836-840, doi: [10.1002/prai.2.873](https://doi.org/10.1002/prai.2.873).
- Sitaridis, I. and Kitsios, F. (2024), "Digital entrepreneurship and entrepreneurship education: a review of the literature", *International Journal of Entrepreneurial Behavior and Research*, Vol. 30 Nos 2/3, pp. 277-304, doi: [10.1108/ijeb-01-2023-0053](https://doi.org/10.1108/ijeb-01-2023-0053).
- Sunyaev, A. (2020), *Internet Computing: Principles of Distributed Systems and Emerging Internet-Based Technologies*, Springer Nature.
- Thorpe, C. and Gunton, L. (2022), "Assessing the United Nation's sustainable development goals in academic libraries", *Journal of Librarianship and Information Science*, Vol. 54 No. 2, pp. 208-215, doi: [10.1177/09610006211005528](https://doi.org/10.1177/09610006211005528).
- Tsang, A.L.Y. and Chiu, D.K.W. (2022), "Effectiveness of virtual reference services in academic libraries: a qualitative study based on the 5E learning model", *The Journal of Academic Librarianship*, Vol. 48 No. 4, 102533, doi: [10.1016/j.acalib.2022.102533](https://doi.org/10.1016/j.acalib.2022.102533).
- Ulicane, I., Eke, D.O., Knight, W., Ogoh, G. and Stahl, B.C. (2021), "Good governance as a response to discontents? Déjà vu, or lessons for AI from other emerging technologies", *Interdisciplinary Science Reviews*, Vol. 46 Nos 1-2, pp. 71-93, doi: [10.1080/03080188.2020.1840220](https://doi.org/10.1080/03080188.2020.1840220).
- Wang, D. (2023), "Bibliometric analyses and network mapping on the smart library in Web of Science from 2003 to 2021", *Library Hi Tech*, Vol. ahead of print doi: [10.1108/LHT-08-2022-0361](https://doi.org/10.1108/LHT-08-2022-0361).
- Wang, C. and Si, L. (2023), "A bibliometric analysis of digital literacy research from 1990 to 2022 and research on emerging themes during the covid-19 pandemic", *Sustainability*, Vol. 15 No. 7, pp. 1-18, doi: [10.3390/su15075769](https://doi.org/10.3390/su15075769).
- Wang, J. and Xie, J. (2023), "Exploring the factors influencing users' learning and sharing behavior on social media platforms", *Library Hi Tech*, Vol. 41 No. 5, pp. 1436-1455, doi: [10.1108/lht-01-2022-0033](https://doi.org/10.1108/lht-01-2022-0033).
- Wang, Y.-M., Wei, C.-L. and Wang, M.-W. (2023), "Factors influencing students' adoption intention of brain-computer interfaces in a game-learning context", *Library Hi Tech*, Vol. 41 No. 5, pp. 1594-1620, doi: [10.1108/lht-12-2021-0506](https://doi.org/10.1108/lht-12-2021-0506).

- Wójcik, M. (2021), "Augmented intelligence technology. The ethical and practical problems of its implementation in libraries", *Library Hi Tech*, Vol. 39 No. 2, pp. 435-447, doi: [10.1108/lht-02-2020-0043](https://doi.org/10.1108/lht-02-2020-0043).
- Yip, K.H.T., Lo, P., Ho, K.K.W. and Chiu, D.K.W. (2021), "Adoption of mobile library apps as learning tools in higher education: a tale between Hong Kong and Japan", *Online Information Review*, Vol. 45 No. 2, pp. 389-405, doi: [10.1108/oir-07-2020-0287](https://doi.org/10.1108/oir-07-2020-0287).
- Yoon, J., Andrews, J.E. and Ward, H.L. (2022), "Perceptions on adopting artificial intelligence and related technologies in libraries: public and academic librarians in North America", *Library Hi Tech*, Vol. 40 No. 6, pp. 1893-1915, doi: [10.1108/lht-07-2021-0229](https://doi.org/10.1108/lht-07-2021-0229).
- Yu, P.Y., Lam, E.T.H. and Chiu, D.K.W. (2023a), "Operation management of academic libraries in Hong Kong under COVID-19", *Library Hi Tech*, Vol. 41 No. 1, pp. 108-129, doi: [10.1108/lht-10-2021-0342](https://doi.org/10.1108/lht-10-2021-0342).
- Yu, W., Jiang, Y. and Fu, T. (2023b), "Digital reading: a bibliometric and visualization analysis", *Library Hi Tech*, Vol. ahead-of-print, doi: [10.1108/LHT-06-2023-0240](https://doi.org/10.1108/LHT-06-2023-0240).
- Zhao, X., Sbaffi, L. and Cox, A. (2023), "The digitisation of writing in higher education: exploring the Use of wordtune as an AI writing assistant", doi: [10.31219/osf.io/uzwy7](https://doi.org/10.31219/osf.io/uzwy7).
- Zhao, X., Cox, A. and Cai, L. (2024), "ChatGPT and the digitisation of writing", *Humanities and Social Sciences Communications*, Vol. 11 No. 1, pp. 1-9, doi: [10.1057/s41599-024-02904-x](https://doi.org/10.1057/s41599-024-02904-x).
- Zhou, J., Lam, E., Au, C.H., Lo, P. and Chiu, D.K.W. (2022), "Library café or elsewhere: usage of study space by different majors under contemporary technological environment", *Library Hi Tech*, Vol. 40 No. 6, pp. 1567-1581, doi: [10.1108/lht-03-2021-0103](https://doi.org/10.1108/lht-03-2021-0103).
- Zhu, J. and Liu, W. (2020), "A tale of two databases: the use of Web of Science and Scopus in academic papers", *Scientometrics*, Vol. 123 No. 1, pp. 321-335, doi: [10.1007/s11192-020-03387-8](https://doi.org/10.1007/s11192-020-03387-8).

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