THE CONSORTIUM OF TANZANIA UNIVERSITY AND RESEARCH LIBRARIES (COTUL)

PROCEEDINGS OF

THE 6TH COTUL SCIENTIFIC CONFERENCE

11TH TO 12TH NOVEMBER 2024
AT TMDA, MWANZA, TANZANIA

THEME

"LIBRARIES AND INFORMATION SERVICES IN THE 4TH INDUSTRIAL REVOLUTION: CURRENT TRENDS, OPPORTUNITIES AND CHALLENGES"

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Edited by

Sydney E. Msonde, Kelefa T. Mwantimwa and Paul S. Muneja

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FOREWORD

The Consortium of Tanzania University and Research Libraries (COTUL) is a formally registered association of higher education and research institutional libraries from both public and private sectors. It was established as a volunteer organization in 2008 to collaborate on information sharing. Specifically, it supports the joint acquisition of electronic information resources and provides capacity-building for its members to strengthen the core functions of teaching, learning and research in Tanzania. COTUL was officially registered in 2017 by the Ministry of Home Affairs under Reg. No. S. A. 21148 according to the Societies Act, CAP. 337 R. E. 2002.

The 2013 COTUL Annual General Meeting (AGM) held at Ruaha Catholic University in Iringa Region decided, among other issues, to start organizing scientific conferences to share research knowledge and expertise among information professionals in the country and beyond. Since then, six scientific conferences have been held. The most recent COTUL scientific conference took place in November 2024 at TMDA in Mwanza, where 24 papers were presented under the main theme: "Libraries and Information Services in the 4th Industrial Revolution". Therefore, COTUL is pleased to publish 10 papers that were accepted and met the criteria for publication merits in its 6th conference proceedings.

On behalf of the COTUL Executive Committee and the Conference Organizing Committee, I would like to sincerely thank all authors, conference participants, sponsors, employers and other individuals for their contributions, which have made the Scientific Conference successful.

Dr. Sydney E. Msonde
COTUL Chairperson

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Libraries and Information Services in the Fourth Industrial Revolution: Current Trends, Opportunities and Challenges

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Abstract
Industrial Revolution (IR) is a phase of technological and innovative changes aimed at solving societal problems. Over the centuries, industrial revolutions have profoundly transformed economic, social and cultural landscapes. The advent of the Fourth Industrial Revolution (4th IR) brings forth a convergence of digital, biological and physical systems, introducing groundbreaking technologies and trends. These innovations, particularly in Library and Information Science (LIS), have transformed traditional services and offered unprecedented opportunities while also presenting significant challenges. This paper explores the evolution of industrial revolutions, with a focus on the 4th IR's technologies and trends, their impact on LIS and actionable strategies to harness these changes effectively. The first up to the current phase (4th IR) were triggered by discoveries that spurred massive productions in industries, computer-aided economic and social transformations and the Internet. Each of these phases had implications for the growth of LIS.

Keywords: *Industrial revolution, LIS, Current trends, Emerging technologies*

Introduction

"The illiterate of the 21st Century will not be those who cannot read and write but those who cannot learn, unlearn and relearn" Alvin Toffler, an American writer, futurist and author (1928 - 2016).

Library and Information Services (LIS) is a set of organized services and resources that are designed to meet the information, research and educational needs of a specific community or user group by facilitating access to knowledge, data and information in various formats. Librarians and information professionals help to create and maintain information systems that allow access to knowledge across the globe (Saykılı, 2019). They provide user education by assisting people in acquiring information literacy that enable them to find, evaluate and use information efficiently.

LIS is the core of knowledge management and exchange in today's world. Its advantage is that it fosters information literacy. Now, more than ever, with increased information overload and fake news, it is crucial to be able to filter sources and distinguish legitimate information. LIS gives people resources to get through the maze of information, which promotes informed citizenship and helps them to make decisions with the correct knowledge. This reciprocal relationship with information is the heart of democracy and social advancement.

LIS is a force for social equity and inclusion (Kosmicki, 2019). In pushing for open access to information and its policy, the discipline has played a role in the democratic aggregation of knowledge. Access to information is always linked to social power, and LIS aims to remove barriers that prevent excluded communities from having access to information (Strover *et al.*, 2020). The social justice agenda is deeply embedded in the LIS profession, with libraries serving everyone, regardless of background. By creating inclusive spaces, LIS promotes social cohesion and empowers diverse groups, contributing to a more equitable society (Gibson *et al.*, 2017).

Traditionally, libraries have been seen as repositories of books and information—essential hubs for knowledge, research and lifelong learning. However, the rapid advancement of the Fourth Industrial Revolution (4th IR) technologies is reshaping this traditional perception, challenging libraries to redefine their roles in a digital and data-driven era. Sife and Matto (2023) have thoroughly emphasized the importance of addressing this need, providing detailed analysis and supporting evidence to highlight its relevance in the current context.

The emerging 4th IR technologies—such as artificial intelligence (AI), the Internet of Things (IoT), big data analytics and automation—present both opportunities and challenges for the LIS field (Lippincott *et al.*, 2021). They can revolutionize LIS through better service delivery, resource management optimization, and enhanced user engagement using data analytics and personalized experience. For example, Ishengoma (2024) found that by using IoT, libraries could improve their space utilization while AI enables automated cataloguing, and big data analytics helps libraries understand user behaviour and preferences (Ishengoma, 2024). The adoption of 4th IR technologies in LIS operations has progressed at a slow pace, which varies significantly from region to region, particularly in areas that lack sufficient digital infrastructures and financial backing. Traditional service models maintain control in many libraries, thereby restricting their capacity to fulfill

digital-age user demands and take full advantage of new technologies. The disparity between technological developments and their uptake in LIS institutions shows why strategic planning is essential to overcome obstacles to successful technology integration.

The widespread adoption of 4th IR technologies in LIS institutions is impeded by insufficient technological infrastructures combined with low digital literacy among library staff and serious data privacy and security concerns alongside financial challenges (Lippincott *et al*., 2021). Budget restrictions and insufficient skilled staff create obstacles for LIS institutions to obtain and operate advanced technological systems. The swift advancement of technology creates doubts about how LIS institutions can maintain sustainability while adapting to these new trends. Libraries could become obsolete and fail to fulfill their users' evolving information needs if they lack a defined plan to adopt 4th IR solutions (Diseiye *et al.,* 2024). LIS institutions must investigate strategies to utilize 4th IR technologies and overcome their existing challenges. A complete evaluation of LIS institutions' preparedness to implement advanced technologies alongside capacity-building programs and policy development must occur to achieve sustainable and inclusive digital transformation.

This research work sought to address the impact of 4th IR technologies on library and information services, focusing specifically on AI and IoT integration, data analytics and virtual/augmented reality to improve library functions and user experiences. It presents an analysis of the advantages and difficulties of implementing these technological advances. The study discusses how libraries can integrate new technologies with their existing services to create inclusive and user-centred spaces.

The contribution of this research lies in its exploration of how libraries can implement 4th IR technologies into their operations to develop practical solutions that enhance services and user experiences. This study presents a strategic framework based on "4R" solutions—Remoulding operations, Reinventing business models, Reorganizing work processes and Remodelling job roles—to guide libraries in adapting to technological advancements. While the study analyses global trends, its findings and recommendations are particularly relevant to libraries in developing countries, such as Tanzania, which are in the early stages of developing technological integration strategies and enhancing their professional and infrastructure capacities.

Industrial revolutions trends and theoretical framework

Industrial revolution trends

Industrial revolutions (IRs) are commonly referred to as significant shifts in technological, economic and social systems that fundamentally transform industries, modes of production and societies (Schwab, 2016; Landes, 1969). Figure 1 summarizes the key characteristics of the IRs:

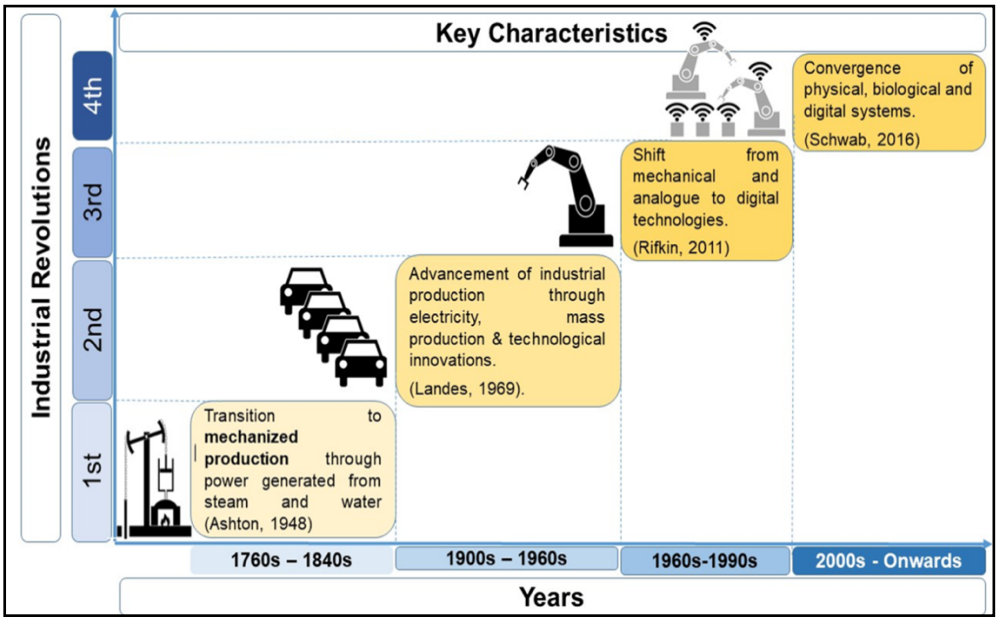

Figure 1: Characteristics of the Industrial Revolutions (1st - 4th Phase)

The First Industrial Revolution which ran from the late 18th to early 19th Century, was characterized by a shift from agricultural to industrial economies (Ashton, 1948). Trends included factories, urbanization as workers went out of the countryside to work and the creation of new forms of labour. For LIS, this was the age of systematic information organization, with cataloguing and bibliographies emerging as a means of formalizing knowledge management.

The Second Industrial Revolution, which occurred between the late 19th and early 20th centuries, brought rapid technological advancements, including the advent of electricity, mass production, the telegraph and telephone. These innovations helped to transform commerce and communication into global phenomena, allowing information to flow more freely across borders. In LIS, this revolution saw the ubiquity of libraries and information centres as points of exchange for

knowledge. It also led to the emergence of standards for information management to cope with the rising complexity of information resources.

The Third Industrial Revolution, or Digital Revolution, began in the mid-20th Century and continued into the late 20th Century. That is when computers, digital technology and the Internet became popular. Some of the trends driving this revolution were the automatization of work, the inception of information technology and the democratization of information. For LIS, this phase revolutionized storage, retrieval and transmission of data. Libraries began implementing electronic catalogues, and the advent of online databases changed the way information was accessible. Additionally, information literacy emerged, emphasizing how users should learn to navigate the new digital world.

The Fourth Industrial Revolution in the present moment is defined as a combination of cutting-edge technologies such as artificial intelligence (AI), big data analytics, the Internet of Things (IoT) and blockchain (Xu *et al.*, 2018). Schwab (2025), who coined the term, describes it as a series of social, political, cultural and economic revolutions marked by the union of physical, digital and biological systems and unprecedented transformations in the way individuals and institutions access information. The most prominent themes in the 4th IR are the advent of innovative technology, personalization of information services and data-driven decision-making. In the context of LIS, this revolution brings both promise and uncertainty. Libraries and information organizations are increasingly using AI and machine learning to optimize user experience and data discovery. However, privacy, ethics and the digital divide are all challenges that need balancing (Hussain, 2020). With the 4th IR unfolding, LIS needs to keep up and be flexible enough to serve the information needs of different communities.

Theoretical framework

This study relied on Actor-Network Theory (ANT) to explore the complex dynamics involved in incorporating 4th IR technologies into library environments. ANT best serves as the analytical framework as it examines both human and non-human elements as active network participants in an evolving socio-technical climate (Latour, 2005). Reflecting on the ANT, various elements—such as librarians, patrons, policies and technologies like AI and IoT—constantly renegotiate and redefine their roles. This dynamic interaction contrasts with Socio-Technical Systems Theory (STST), which focuses on more static relationships between social and technical components without fully capturing their evolving interdependencies (Trist & Bamforth, 1951; Gorejena *et al.,* 2016;

Xu & Gao, 2024). Likewise, the Diffusion of Innovations (DoI) Theory is less relevant in this context. Despite its strength in examining adoption processes and technological spread mechanisms (Amini & Jahanbakhsh Javid, 2023; Minishi-Majanja & Kiplang'at, 2005), it fails to account for power dynamics and resistance patterns within library technology implementation.

The study interprets 4th IR technologies like AI, IoT and Blockchain as active participants in a wider socio-technical network instead of simple technological improvements to library infrastructures. It investigates the interactions between 4th IR technologies and their impact on library operations through engagement with library staff, patrons, administrators and external technology providers. Thus, this study relied on ANT to present technological adoption as a process where technologies actively reshape library relationships and practices instead of existing as mere technical upgrades.

The foundational "translation" concept from ANT delivers powerful analytical tools for studying how AI, IoT and Blockchain transform library functions. In the context of ANT, translation signifies the way technologies, along with their original intention, become redefined through the interpretations of network actors. The process at libraries includes librarians together with patrons and institutional policymakers who work to define how emerging technologies will function within their organizational framework. Library staff members see AI as a means of enhancing information search and tailor services, but patrons understand AI systems in terms of convenience and efficiency. At the same time, institutional regulators and technology providers actively promote applications of these technologies that reflect economic interests or policy objectives. ANT enables researchers to analyze multiple layers of interpretation for 4th IR technologies while exposing the mechanisms that influence their implementation and utilization.

The 4th IR technologies and trends in library and information science

4th IR technologies

The 4th IR is a transformation that combines innovative technologies to transform the entire field of LIS. This revolution is a system-converging process and has brought essential patterns into play that are changing how libraries operate and how information is retrieved, stored and used. Figure 2 summarizes the key technologies marking the 4th IR:

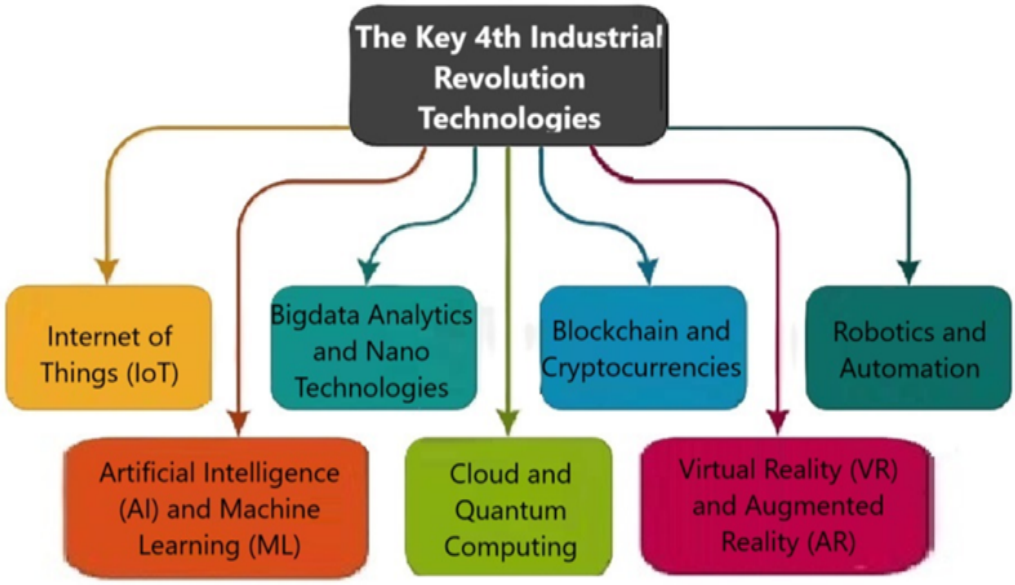

Figure 2: Digital Technologies Making the 4th IR
Source: Authors' processing

Artificial Intelligence (AI) and Machine Learning (ML)
AI is a type of human-like machine that has reasoning, decision-making, learning and interpersonal skills. ML as part of AI is a computer program that performs jobs that generally require human intellect. AI typically frees human beings from some tasks so that they can efficiently use the saved time for other essential tasks.

Big Data Analytics
Big Data is an information asset characterized by considerable volume, high velocity and different varieties of data that require specific technology and analytical methods for its transformation into value. Big Data and other 4th IR technologies enhance librarians' value by creating value in bibliometrics, data sharing and data curation.

Internet of Things (IoT)
IoT refers to the network of physical devices, vehicles, appliances and other items embedded with sensors, software and connectivity that enable them to collect and exchange data. These IoT devices connected to the Internet can communicate with each other and with users, enabling automation, monitoring and control without direct human intervention.

Cloud Computing

Cloud computing refers to the delivery of computing services such as storage, processing power, and software applications over the Internet. It enables individuals and organizations to access and use resources without having to own and maintain physical hardware.

Blockchain

Blockchain is a decentralized, distributed ledger service that accurately records the origin of digital items (Reddy & Kalpana, 2021). Blockchain technology can address the challenges by improving the following: Transparency in the supply chain of library materials, traceability of consumer products, financial options for libraries, timely payments and access to information.

Virtual Reality (VR) and Augmented Reality (AR)

VR and AR use computer-generated simulations which create a sense of immersion by combining digital technology with the real environment. They blend the physical world with digital experiences, but they differ in their approach and use cases. While VR creates an entirely immersive digital environment that replaces the real world, typically viewed through a specialized headset, AR overlays digital content on top of the real world rather than replacing it.

Robotics and Automation

Automation involves the use of technology to carry out tasks with little or no human intervention. It aims to increase efficiency, accuracy and consistency in various processes. Robotics is a subset of automation that deals explicitly with machines capable of performing physical tasks—often mimicking human actions. However, automation is a much broader concept that also includes software-based systems such as robotic process automation (RPA), which automate repetitive digital tasks like data entry, scheduling or customer service interactions. Together, robotics and automation are transforming industries by streamlining operations, reducing costs and improving productivity.

Web and library generations

The movement from the Web revolutions (Web 1.0, 2.0, 3.0 and now 4.0) to their related library revolutions (Lib 1.0, 2.0, 3.0 and 4.0) provides a framework for focused paradigm shifts driven by IRs as depicted in Figure 3:

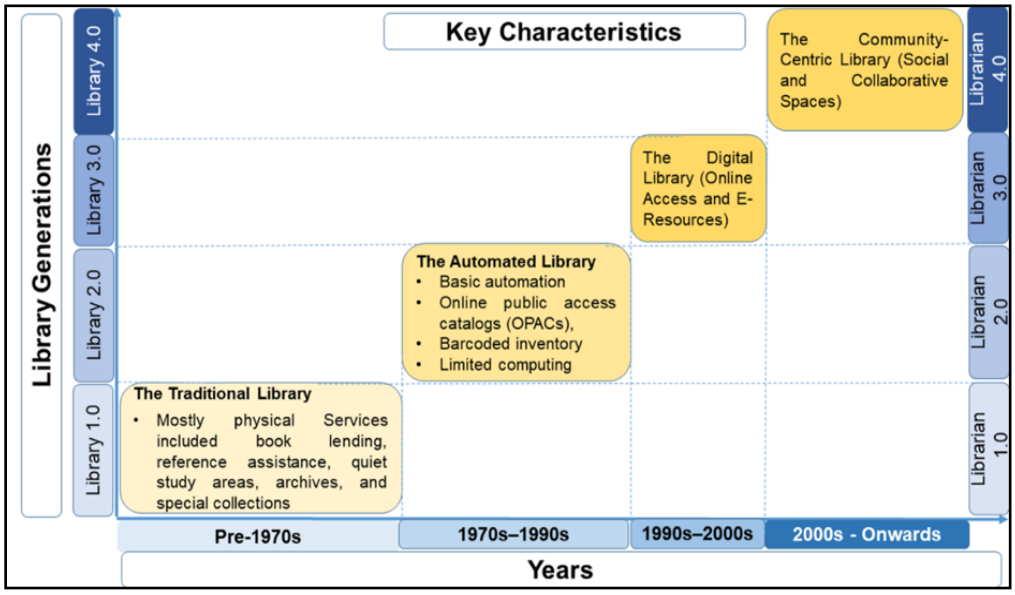

Figure 3: Library Generations

Source: Authors' processing

Web 1.0, with its static pages and read-only web, formed the basis for the spread of information and libraries essentially functioned as storage centres for print sources (JinCheng & Chuen, 2024). Across the globe, online catalogues and library collections became digitized in this period, enabling even wider information access. As the web turned into Web 2.0, a new emphasis was placed on user content and interactivity; libraries also rolled out social media and collaborative tools to drive users' engagement and engagement with their community (O'Dell, 2020). The evolution of Library 2.0 followed the same pattern, with libraries no longer passive consumers of knowledge but active community centres. Library 3.0 and Web 3.0 reflected the importance of semantic web technologies, enabling intelligent information-retrieval engines that provided users with content tailored to their requirements and interests. Here, libraries started leveraging linked data principles and knowledge graphs for discoverability and improved user experiences. Library 4.0 and Web 4.0, two other technologies of the 4th IR, put emphasis on hyper-connectivity.

Artificial Intelligence (AI) and personalization

Libraries use AI-based technologies to interpret user data and preferences and thus provide individualized information services for greater user satisfaction

(Msauki, 2021). Personalized recommendation systems, for example much like commercial services such as Netflix and Amazon recommend items based on interactions and preferences that the user has had in the past to help create a more dynamic and meaningful library. Furthermore, the integration of Internet of Things (IoT) devices can transform libraries into innovative and tech-enabled environments. Examples include intelligent shelving systems that automatically track inventory and usage data, as well as interactive kiosks that assist users in locating resources more efficiently (Bi *et al.*, 2022).

4th IR technologies trends in library and information services

The integration of 4th IR technologies with advancements in the web and library systems is reshaping how libraries are managed and how they deliver services. Libraries are evolving from static repositories of information into dynamic knowledge ecosystems that foster collaboration, innovation and strengthen community engagement. One of the most prominent innovations is integrating AI into library systems to allow better user experience through smart searches, personalized recommendations and resource optimization. For instance, AI-enabled chatbots can increase engagement and deliver instantaneous answers to users' questions, freeing librarians to engage in more challenging tasks and interactions that require human intervention. AI algorithms can also look at patterns of borrowing to recommend suitable resources to users in their areas of interest and offer a more individualized and immersive learning experience.

A further area of great potential is the implementation of blockchain technologies in LIS, especially data security and integrity. Libraries can harness blockchain to create open, decentralized systems for managing scholarly articles and data that enable authors to remain in control while still granting access to the work (Emmanuel *et al.*, 2023). For example, blockchain can be used to control digital rights, allowing libraries to monitor usage rights and maintain copyright compliance. Moreover, blockchain can improve trust in scholarly communication and facilitate equal access to knowledge by providing an open, decentralized system for sharing and confirming information (Abid, 2021).

The Internet of Things offers multiple applications within libraries and information services with specific benefits for communication handling and staff management. The Internet of Things devices, including smart sensors and connected systems, deliver real-time notifications to staff and users to improve response times and boost user satisfaction (Ishengoma, 2024). IoT-enabled devices improve communication efficiency by sending timely alerts about both

upcoming due dates and overdue items alongside new acquisitions. Moreover, IoT technologies enable staff management systems to track work hours and employee locations in the library while monitoring task completion through smart device data (Khan *et al.*, 2022). The use of IoT technology enables libraries to automate standard procedures like book check-ins and check-outs, which allows staff members to dedicate their time to services that enhance value.

Libraries can track their materials in real-time through IoT devices such as RFID tags and innovative shelving systems, which leads to efficient inventory management and fewer errors caused by human oversight (Andhare *et al.*, 2023). Figure 4 further illustrates this:

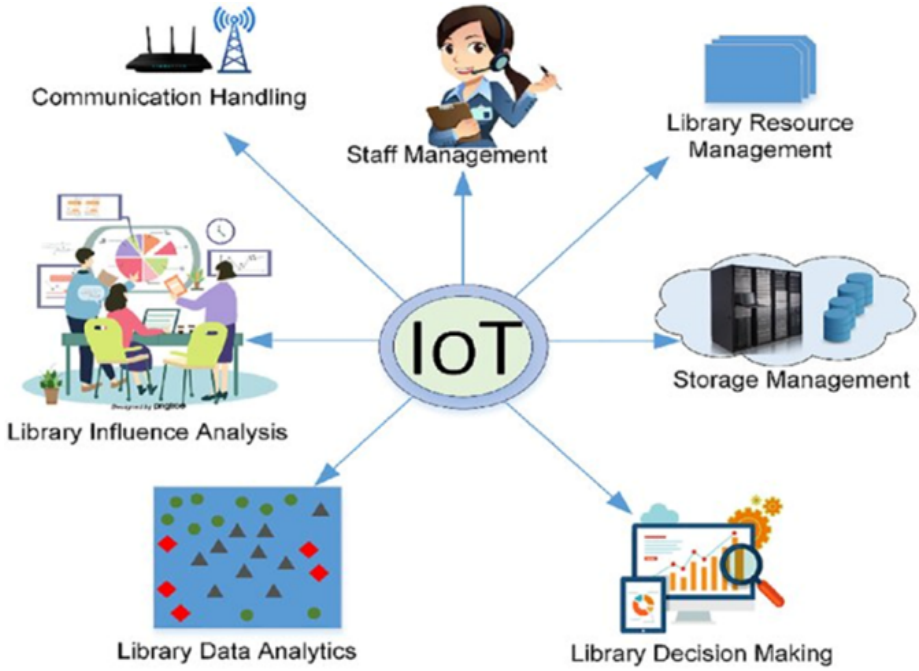

Figure 4: IoT in Library Services

Environmental sensors are used in storage management to track and control temperature and humidity levels to maintain air quality and protect rare books and archival materials. Moreover, IoT-based data collection and analysis supply libraries with valuable information regarding user behaviour patterns and resource usage, which helps identify potential areas for improvement (Zhou *et al.*, 2024). Libraries can use IoT devices to track foot traffic, monitor space usage and analyze how users interact with different areas. This data helps libraries to design

more user-centered services and create spaces that better meet visitors' needs. Using IoT devices, libraries can analyze their influence by monitoring foot traffic patterns, space occupancy and user interaction with varying library areas, which helps to create user-focused services and spaces. The use of big data analytics within library management systems enables libraries to grasp community requirements while delivering effective solutions. Through big data utilization, libraries can gather, and study engagement metrics related to users and resources to create specialized services designed for distinct user groups (Li *et al.,* 2019). Through this data-driven system, libraries can provide personalized services that suggest appropriate materials based on user preferences and activity patterns. Through data analytics, libraries can develop a culture of continuous improvement by evaluating service performance and pinpointing enhancement opportunities. Through this process, libraries can modify their services immediately to match user needs, keeping offerings relevant while creating an ongoing improvement setting that leads to higher user satisfaction. Libraries can make better decisions about resource distribution and strategy development by using big data to forecast trends and demand, which improves service delivery and operational functionality.

4th IR trends: Opportunities and challenges in library and information services

The Strengths, Weaknesses, Opportunities and Challenges (SWOC) Model, as customized in Figure 5, serves as a structured framework for this study:

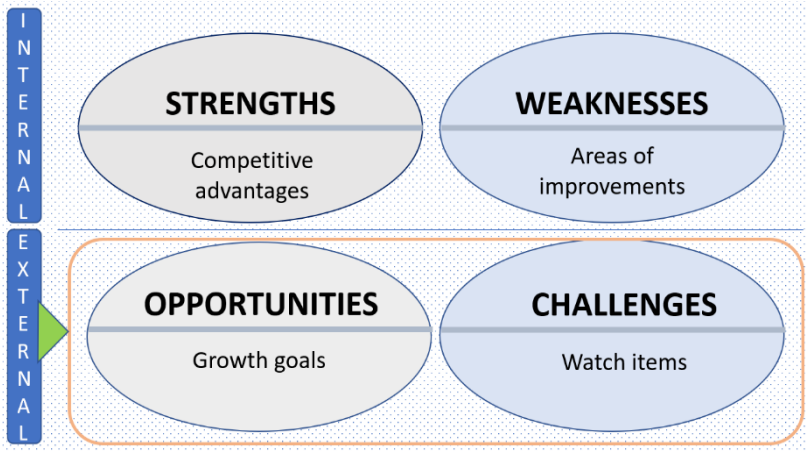

Figure 5: SWOC Model and its Focus in this Context (the lower part)

The model's lower part helps to evaluate libraries' strategic positioning and readiness to engage with 4th IR opportunities and challenges. It allows libraries to discover their internal strengths while pinpointing weaknesses that create barriers to new technology adoption and assess opportunities for growth and innovation as well as external challenges arising from the incorporation of 4th IR tools into their management systems.

Opportunities

To integrate the 4th IR technologies

Adoption of AI, IoT and robotics is essential for enhanced services. The 4th and 5th IRs will be dominated by AI and IoT technologies. Data-driven insights for personalized services: a Library becomes the centre for data curation; thus, value addition is a critical opportunity. IoT devices can track foot traffic, seating usage and space occupancy to understand how patrons use different library spaces. Real-time collection management: the 4th IR technologies will help in monitoring and evaluation of the collections using real-time data.

To enhance user experience

Opportunities include also to develop virtual/augmented reality services. AR and VR tools are used to enhance user experiences. They include to use advanced data analytics to understand user needs; to use big data and data analytics tools as well as AI tools. User experience is enhanced through interactive digital platforms. Provide personalized experiences by tracking user preferences and suggesting relevant resources or events. Enhance personal security and privacy. The use of smart cameras and access control improves the safety of library premises, and IoT-based alarms can alert staff to unauthorized access.

To improve resources management

Optimized space and resource management using IoTs is also inevitable. Energy optimization such as lighting, heating and cooling reduces costs and promotes sustainability. Environmental monitoring to protect collections using IoTs. Monitor and control temperature, humidity and air quality to protect books, historical documents, and rare collections from environmental damage. Intelligent inventory management uses security cameras, RFIDs, and IoT as well as automated book sorting and check-in/out.

To develop professional skills

It is an opportunity for libraries to collaborate with tech companies and universities for training and help to address resource scarcity in terms of human, physical and financial. Other opportunities include to develop specialized skills in AI, data analysis, and IoT; incorporate revised or new curricula across librarian professional levels and promote digital literacy programs for the public. It is also an opportunity for librarians to enhance their competencies, reprofile their skills and reinvent themselves to remain relevant.

To engage the community

Another opportunity is to bridge the digital divide. Libraries promote digital literacy among their users so that they can access and use information resources using various technologies. They support lifelong learning through technology literacy and use 4th IR platforms to support short-, medium- and long-term learning. Expansion of community-based learning with maker spaces and VR labs. Emerging digital technologies create a conducive environment, making the libraries hubs for digital interaction with the communities.

Challenges

Rapid integration of 4th IR technologies

The rapidly changing technology landscape presents a significant challenge for libraries, as technologies may become obsolete before reaching their economic threshold or may require costly upgrades. While data-driven insights offer opportunities for personalized services, concerns about the security and privacy of user data continue to pose barriers to adoption. In addition, implementing real-time collection management systems demands massive investments, often leading to financing challenges that hinder sustainable innovation.

User experience

Balancing traditional and digital services remains a key challenge for libraries, especially as some librarians and users continue to hold negative perceptions of digital services. Managing user expectations and preferences becomes even more complex when users have overly ambitious expectations that do not align with the current realities of digital infrastructure. At the same time, ensuring equitable access to digital resources is critical yet difficult to achieve due to persistent physical and financial challenges that hinder true equitability.

Resources management

The potential loss of jobs due to automation is a significant concern in the context of 4IR integration, with some library staff fearing job displacement and, therefore, showing reluctance toward embracing technological advancements. Furthermore, the fusion of biological, physical, and digital systems characteristic of the 4IR demands specialized skills for effective maintenance and technical support. Without such expertise, the risk of technical failures increases, which could significantly disrupt core university or library services and compromise service continuity.

Professional skills development

There is a continuous need for professional development as rapid technological changes demand frequent updates to staff skills. However, limited training resources, whether human, financial, physical, or time-related—pose significant constraints. Keeping up with evolving skill requirements in the workforce becomes even more challenging when competing priorities, either from staff or employers, delay efforts to address these critical development needs.

Community engagement

Catering to the diverse needs and varying technical skills of users presents a significant challenge for libraries and academic institutions, especially as ensuring inclusivity requires considerable resources. However, financial constraints—particularly in community outreach—remain a persistent issue, with traditional budgets often falling short of what is needed. At the same time, the integration of advanced technologies raises critical ethical concerns, including biases in AI systems and the growing potential for unethical behavior. The rise of large language models (LLMs) and AI-powered tools like chatbots has intensified worries, as they may inadvertently motivate academic dishonesty. One alarming manifestation of this is the surge in paper mills, which exploit such technologies to produce fraudulent research. According to Nature, 2023 saw a record-breaking 10,000 research retractions, while Candal-Pedreira *et al* (2022) had already noted that by 2021, paper mill retractions made up 772 (21.8%) of the 3,544 total retractions—highlighting a troubling trend as 4th IR technologies gain ground. Qi *et al* (2024) present observations in three countries: China, U.S.A and India (Figure 6).

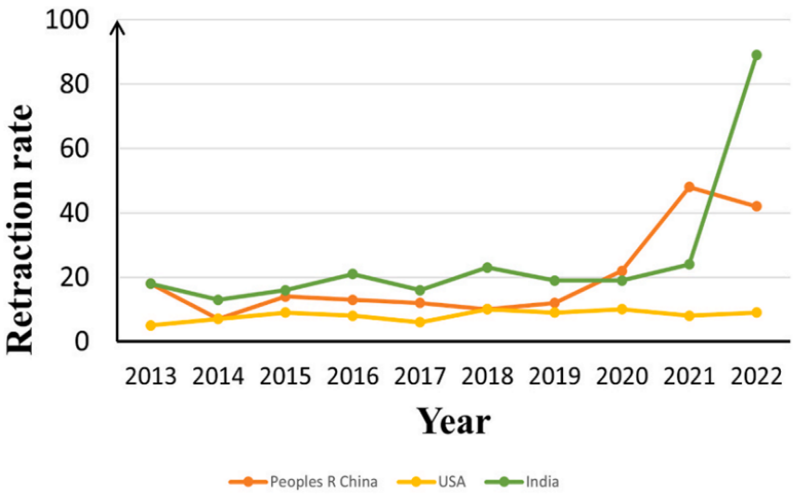

Figure 6: The Retraction Rate of Articles per 10,000 Published Articles in China, USA and India from 2013 to 2022
Source: Qi *et al* (2024)

According to these observations, the retraction rate of academic publications in India and the People's Republic of China has increased rapidly since 2020, while the rate in the United States has remained relatively controlled. This disparity can be partly explained by the rapid adoption of emerging technology trends in China and India, which, while accelerating research output, may also be contributing to lapses in research integrity and quality assurance mechanisms.

4th IR: Implications for library and information services

There is an urgent need to revisit and modernize traditional frameworks and models that have historically shaped the foundation of librarianship, particularly the theories and principles that guide professional practices. As the information landscape evolves with the integration of digital technologies and shifting user expectations, it is essential that professional development programmes reflect current realities. These programmes must be designed with an emphasis on equity and inclusion, ensuring accessibility and relevance for all staff regardless of sex, educational background or special needs. Inclusivity should not only be reflected in the content but also the methods of delivery and engagement. Furthermore, deliberate efforts are needed to address and positively transform staff attitudes toward change, technology and continuous learning. Encouraging a culture of openness, adaptability and innovation is key to equipping library professionals with the skills and mindset needed to thrive in dynamic environment shaped by

the 4th IR and beyond. Table 1 summarizes opportunities and challenges of the 4th IR in library and information services:

Table 1: Opportunities and Challenges of 4th IR in Library and Information Services

Category	Point	Example
Opportunities	Tech Integration: Use AI, IoT and robotics to improve services.	AI recommendations and IoT-based inventory management.
	User Experience: Offer VR/AR for immersive learning.	Virtual library tours and VR-based educational content.
	Space Management: IoT is used for efficient energy and space use.	Smart lighting and energy-saving systems.
	Professional Skills: Collaborations for staff training in new tech.	Training in data analysis and AI tools.
	Community Support: Libraries bridge the digital divide.	Coding workshops and maker spaces for community involvement.
Challenges	Tech Integration: Keeping with rapidly changing technologies.	High costs and risk of obsolescence if tech changes quickly.
	User Expectations: Balancing traditional services with digital ones.	Resistance to digital services from certain user groups.
	Job Loss: Automation could lead to job reductions.	Resistance from staff fearing job cuts.
	Continuous Training: Staff need ongoing development to keep up with new tech.	Limited funding for continuous professional development.
	Ethical Considerations: Ensuring equitable access and privacy in AI usage.	Addressing privacy concerns and ensuring fairness in AI usage.

Conclusion and Recommendations

Libraries have significant opportunities to enhance service delivery and improve resource management while providing personalized user experiences through the integration of 4th IR technologies. Artificial intelligence, alongside IoT and data analytics, enables libraries to make their operations smoother while optimizing resources and developing engaging environments. Although there are many potential benefits these technologies offer libraries, they still encounter obstacles during full adoption and integration. The disruptive attributes of 4th IR tools, alongside insufficient staff training and data privacy and security worries, are obstacles to their broad implementation. Progress in technology adoption remains slow due to inadequate infrastructure systems, outdated knowledge bases, and the absence of continuous professional development opportunities.

The adoption of 4th IR technologies faces tremendous obstacles in developing countries like Tanzania. The challenge of implementing advanced technologies is intensified by the combination of limited budgets and poor infrastructure along with insufficient skilled staff in libraries. Library staff in these regions are unable to maintain high-quality services because they lack sufficient training and support to keep up with technological advances. Developing countries need to address existing obstacles to realize the full benefits of 4th IR technologies for library service transformation. To address the barriers and improve the integration of 4th IR technologies in libraries, several recommendations, based on the literature, are proposed. First, libraries should remould organizational operations by examining and reshaping key components such as staff, customers, organizational structure, environment, and technology to align with the demands of the 4IR. Second, it is important to reinvent business models by strategically adjusting the library's framework, allowing it to face the challenges and opportunities brought by technological advancements. Third, libraries should re-organize work processes by creating clear policies and procedures that guide staff and customers in using new products and services effectively. Lastly, libraries must re-model job specifications and roles by reviewing and updating job descriptions across all staff levels to ensure they are aligned with the evolving needs of the 4th IR, ensuring that each position supports the library's future success and technological progress.

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Authorship Patterns of Indigenous Knowledge in the Fourth Industrial Revolution: A Bibliometric Systematic Review of Tanzania's Scholarly Journals Indexed by the African Journals Online Database

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Abstract

This study focused on authorship patterns in Indigenous Knowledge Management (IKM) in Tanzania's scholarly journals indexed by the African Journals Online (AJOL) database spotlighting the significance of indigenous knowledge in the Fourth Industrial Revolution (4th IR). Employing systematic literature review and rigorous bibliometric analysis, the study investigated the authorship patterns in this domain. It scrutinized authorship dynamics in 37 Tanzanian journals indexed by AJOL, the indexing platform of African-published journals offering a nuanced portrayal of the scholarly landscape. The analysis focused on articles authored by Tanzanian authors between 2008 and 2013. Descriptive statistics show that the majority (65.6%) of authors opt for single-authored contributions followed by two-author collaborations accounting for 27.9%, hence limited collaborative authorships and multidisciplinary collaboration among authors. These findings underscore the dominance of single-authorship in scholarly publications, with limited collaborative authorships among authors from different geographic regions and interdisciplinaries which may not fully leverage the potential of interdisciplinary collaboration essential for fostering innovation and inclusive development in the 4th IR. The findings in this study provide extra weight to the need for a paradigm shift towards collaborative authorship and interdisciplinary engagement. Such a shift is vital for effective indigenous knowledge transfer within academia, particularly amidst Tanzania's industrialization efforts in the context of the Fourth Industrial Revolution.

Keywords: *Authorship patterns, Bibliometric analysis, Knowledge management, Tanzania, Fourth Industrial Revolution.*

Introduction

Tanzania possesses a rich and diverse academic heritage, deeply influenced by its vast cultural affiliations and the presence of over 120 tribal groups. The Indigenous Knowledge (IK) of these tribal groups encompasses areas such as education, social structures, cultural practices, environmental management, agriculture, animal husbandry, medicinal knowledge, craftsmanship, spiritual beliefs, economic activities, witchcraft, sorcery, magic and divination. Such knowledge has long played a critical role in fostering national integration and development in the Fourth Industrial Revolution (4th IR) (Mchombu, 2016; Zawawi, 2023). Studies on IK by Tanzanian scholars significantly shape the country's academic landscape, particularly as the nation advances towards industrialisation within the framework of the 4th IR (Ndunguru, 2017; Wamala, 2021).

While the richness of IK forms a critical foundation for Tanzania's academic and developmental trajectory, understanding how this knowledge is produced and shared is equally important. Existing trends reveal a predominance of single-authored works, raising concerns about the collaborative authorship and inclusivity of the existing Indigenous Knowledge Management (IKM) practices amid the rapid technological advancements in the 4th IR. This highlights the need for more collaborative and interdisciplinary approaches to IK production. Studies emphasize that collaborative authorship and inclusivity are essential for facilitating effective knowledge transfer among scholars and institutions (Mchombu, 2016; Wamala (2021). Ndunguru (2017) highlights the importance of interdisciplinary collaboration in IK production, suggesting that such engagement enhances the richness and applicability of the knowledge. However, despite the increasing body of scholarship on IK in Tanzania, a notable gap persists in comprehensive analyses of authorship patterns and collaborative networks within this domain (Mchombu, 2016; Zawawi, 2023). Therefore, understanding authorship patterns in the IK field is essential for evaluating knowledge production, dissemination dynamics and their subsequent impacts on the academic landscape and national development in the 4th IR.

This study explored the dynamics of authorship and citation patterns within Tanzania's IKM literature. Through rigorous bibliometric analysis and an in-depth review of scholarly contributions from 2008 and 2013, the study mapped

the landscape of knowledge production in this field. It identified key publication platforms, highlighting significant scholarly contributions, and exposing the limitations of current collaborative networks. Moreover, the study proposed pathways to foster a more collaborative authorship paradigm, which is critical for advancing effective IKM strategies. Furthermore, the study evaluated Tanzanian scholars' authorship patterns in IKM, with a specific focus on publishing trends and scholarly collaboration across Tanzania, analyzed IK citation patterns, author affiliations and knowledge transfer mechanisms.

This study sought to offer valuable insights into the role of scholarly publishing in promoting collaborative authorship and interdisciplinary engagement within the broader context of national integration and 4th IR. The study aimed to contribute to the broader discourse on IK, emphasizing its critical role in supporting Tanzania's industrialization efforts within the context of the 4th IR. By examining current authorship trends, the study advocated for practices that embrace greater collaboration, thus enhancing the role of IK in an increasingly interconnected world in the 4th IR. Authorship pattern collaboration is essential for achieving national unity in the management of IK, particularly Tanzania works toward greater industrialization and innovation (Wamala, 2021). Partnerships between scholars from diverse institutions enable the co-creation and dissemination of research findings throughout the country, enhancing the impact of IK in the 4th IR. The specific objectives of this study were as follows:

a) To assess the authorship patterns in indigenous knowledge among Tanzanian scholars;
b) To identify the geographical distribution of the retrieved articles; and
c) To examine regional indigenous knowledge transfer through patterns of authorship collaboration.

Methods and materials

This study incorporated a systematic review and bibliometric analysis to investigate authorship patterns and a comprehensive overview of the scholarly landscape, focusing on article selection criteria, data collection procedures and analytical techniques within IKM in Tanzania in the context of the 4th IR. A bibliometric method was applied to survey articles published by journals indexed in AJOL between 2008 and 2013. A total of 61 articles were retrieved and used for the analysis based on predefined selection criteria.

Criteria for selecting articles

To ensure a rigorous and relevant data set, specific inclusion criteria were established to guide article selection as follows:

(i) Relevance: Articles must focus on IKM, authorship patterns and the implications of their themes in the context of the 4th IR.

(ii) Time Frame: Only articles published between 2008 and 2013 were included to ensure that the study captures the most recent developments and trends in the field.

(iii) Peer-Reviewed Status: Only peer-reviewed journal articles were included to maintain the high quality and credibility of the data collected.

(iv) Geographical Focus: Articles about Tanzania or case studies involving Tanzanian IKM.

Data collection procedures

A detailed selection process of the identified articles was conducted through the following steps:

(i) Initial screening: Titles and abstracts of retrieved articles were reviewed to determine their relevance to the themes of the study.

(ii) Full-text review: Relevant articles were reviewed in full-text to ensure that they met the inclusion criteria.

(iii) Data extraction: Key information was extracted from the selected articles, including author's name, publication year, journal name, number of authors and types of collaboration (e.g., single-authored vs. multi-authored publications).

Analytical techniques

The collected data was subjected to quantitative analysis using bibliometric techniques. Descriptive statistics were employed to analyze authorship patterns to provide insights into authorship patterns in IKM, particularly the prevalence of single authorship versus co-authorship practices. The analytical techniques focused on the following aspects:

(i) The total number of articles published;

(ii) The proportion of single versus multi-authorship of publications; and

(iii) The frequency of collaborations among authors from different institutions.

Authorship management in IK within the 4th IR context

The authorship management practices observed in the IKM literature revealed limited collaboration. The results showed a significant 72 percent of articles which were single authored, suggesting a need for improved authorship patterns that encourage co-authorship and interdisciplinary engagement. Based on authorship structures, the findings identified publication trends marked by limited collaboration and highlighted gaps in collaborative practices. The results offer valuable insights into how authorship management could be enhanced, particularly in the context of IKM in the 4th IR era.

Degree of authorship collaboration in IK studies

To assess the levels of authorship collaboration, several key metrics were employed:

(i) Collaboration Index (CI): This metric was calculated by dividing the total number of authors by the number of articles. A higher CI indicates a greater degree of collaborative authorship.

(ii) Average number of authors per article (ANA): This metric gauges the typical level of collaboration across the dataset.

(iii) Proportion of multi-authorship of publications: The percentages of articles with two or more authors were analyzed to explore collaborative trends within the field.

(iv) Finally, qualitative insights were gathered by analyzing author affiliations to determine the extent of interdisciplinary collaborative authorships. The analysis revealed patterns of cooperation among researchers from various institutions and disciplines, highlighting the opportunities and challenges in fostering greater interdisciplinary engagement in IKM.

Inclusion and exclusion criteria

The systematic review included articles related to IK studies published in Tanzania's journals indexed in the AJOL database. Articles published outside the specified time range (2008 – 2013) or those not addressing IK were excluded from the analysis.

Search strategy

A rigorous search strategy was implemented to ensure comprehensive coverage of IK-related articles. The search was conducted using keywords, namely

'Indigenous Knowledge,' 'traditional knowledge,' 'local knowledge' and 'Tanzania.' Journals indexed by AJOL provided the basis for the search of journal archives to ensure the inclusion of all relevant articles.

Data extraction and analysis

Data was extracted from each selected article, focusing on authorship patterns, geographical affiliation and knowledge transfer. Simple frequency and percentage analysis were used to assess the collected data, providing insight into trends in authorship and collaboration in Tanzania's scholarly publications on IK.

Findings of the study

Authorship patterns

Table 1 presents the authorship patterns in Tanzanian journals indexed by AJOL on IK studies across the selected years:

Table 1: Authorship Patterns in Tanzanian Journals Indexed by AJOL

Year	Single Author	Two Authors	Three Authors	Four Authors	Five Authors and above	Total
2008	9	5	-	1	-	**15**
2009	13	6	1	-	-	**20**
2010	7	1	-	-	-	**8**
2011	5	1	-	-	-	**6**
2012	4	2	-	-	-	**6**
2013	2	2	2	-	-	**6**
Total	**40**	**17**	**3**	**1**	**0**	**61**

The results, as illustrated in Table 1, show that contributions from single authors are predominant, comprising 65.6% of the total articles. Collaborations between two authors account for 27.9%, while publications with three and four authors account for 4.9% and 1.6%, respectively. Number articles with five or more authors were published during the study period.

Geographical origin of the published articles

Table 2 illustrates the geographical origins of articles published in Tanzania's journals that are indexed by AJOL:

Table 2: Geographical Distribution of Articles Published in Tanzania's Journals

Year	North-West	North-East	North-Central	South-South	South-East	South-West
2008	11	-	1	3	-	-
2009	16	-	2	2	-	-
2010	6	-	2	-	-	-
2011	2	2	-	2	-	-
2012	5	-	-	1	-	-
2013	6	-	-	-	-	-
Total	**46**	**2**	**5**	**8**	**-**	**-**

The results, as indicated in Table 2 show that most articles (75.4%) were from the north-western region of Tanzania, where many academic institutions and IK research hubs are concentrated. In contrast, the north-eastern, north-central and south-south exhibited limited representation, while south-eastern and south-western regions contributed no articles. This geographical disparity highlights the concentration of IK studies in certain regions of Tanzania, which could impede the inclusive representation of collaborative authorship of IK.

Regional indigenous knowledge transfer through the patterns of authorship collaboration

Table 3 details the extent of knowledge transfer between different geographical regions based on authorship collaboration patterns:

Table 3: Knowledge Transfer through Collaborative Authorship

Type of Author	North West-North West	North West-North West	North West-North Central	North West-South West	North West-South East	North West-South South	Total
One Author	-	2	2	-	-	3	7
Two Authors	11	-	3	-	-	4	18
Three Authors	2	-	-	-	-	-	2
Four Authors	1	-	-	-	-	-	1
Five & above	-	-	-	-	-	-	-
Total	**14**	**2**	**5**	**-**	**-**	**7**	**28**

Results in Table 3 reveal a deficiency in knowledge transfer between regions, as half of the collaboration occurs solely in the northwestern region. This suggests a limited level of engagement and cross-regional collaboration in IK. Collaborations involving two authors were predominant, suggesting that smaller collaborative efforts have more significant implications for knowledge transfer than larger, multi-author collaborations. In contrast, collaboration involving three or more authors was rare, highlighting a need for increased interdisciplinary and inter-regional partnerships to enhance the dissemination of IK across Tanzania.

Discussion

The findings of this study indicate significant trends in authorship patterns carrying critical implications for fostering 4th IR in Tanzania. In contrast to earlier studies (see, for instance, Hosseini *et al.,* 2024) that highlighted a preference for multiple authorship amongst authors, the present study's findings indicate a significant prevalence of single-authored articles among a considerable portion of the analyzed articles. The fact that single-authored articles constitute 65.6% of the total articles indicates a propensity for individual contributions. While such individual contributions are valuable, this trend may inhibit the collaborative efforts necessary for incorporating diverse IKM into modern knowledge management frameworks. The lack of co-authorship limits interdisciplinary collaboration, which is crucial for addressing the complex and multifaceted nature of IK. Consequently, in accordance with Kassim (2023), this study advocates for the imperative of global collaborative authorship to facilitate the transfer of knowledge, experiences and innovations for national development in the 4th IR.

Additionally, the concentration of publications from a single geographic region suggests uneven dissemination of IK, potentially sidelining perspectives from other indigenous communities in Tanzania. Considering that effective IKM relies on inclusive participation and representation of various indigenous communities, this imbalance may hinder the integration of diverse local systems. To support Tanzania to embark in the 4th IR, it is crucial to cultivate a more collaborative research environment that promotes co-authorship among academics, practitioners and IK stakeholders from different geographical areas in the country. This collaborative approach would enhance the relevance and

applicability of research output to ensure that IK informs technological innovation and policy development in Tanzania.

Authorship communication patterns of research outputs play an essential role in knowledge sharing, particularly in advancing IKM practices. The low rates of collaborative authorship observed in this study suggest that researchers often operate within isolated disciplinary silos, limiting opportunities for dialogue and exchange across fields. This kind of approach weakens the cross-disciplinary collaboration essential for fostering innovative practices in IKM. Additionally, while some articles featured multiple authors, particularly those with two contributors, such instances remain limited indicating that dyadic collaborations predominantly facilitate knowledge exchange. Although this is a valid observation, it also presents certain limitations, as it may indicate restricted networks and a lack of comprehensive disciplinary integration. Collectively, these results underscore a significant deficiency in interdisciplinary and inter-regional collaborations, which are essential for enhancing the breadth and depth of Indigenous Knowledge (IK) research within the varied contexts of Tanzania.

Implications for IKM and 4th IR The observed authorship patterns have significant implications for IKM and Tanzania's broader 4th IR agenda. The dominance of single-authored articles highlights a missed opportunity for collaborative efforts that could harness IK systems more effectively. Collaborative authorship, involving multiple stakeholders in academia, industry and indigenous communities can drive the integration of IK into industrial development initiatives. Such collaboration would be instrumental in utilizing indigenous resources for sustainable industrial growth. Furthermore, the geographic concentration of research outputs, particularly from the northwestern region, underscores the importance of promoting knowledge exchange and collaboration across diverse geographic areas. Geographical diversity in authorship and collaboration could leverage Tanzania's rich cultural heritage and IK assets. In reciprocity, it could stimulate innovation and contribute to industrial development in key sectors, positioning IK as a cornerstone of Tanzania's 4th IR strategy.

Comparison to existing literature and theoretical frameworks

The study findings converge with extant literature on authorship patterns and collaborative research practices in IKM. Similar trends of single-authored publications have been observed in other contexts, indicating a broader preference for individual contributions in academia. However, the implications of these patterns on knowledge transfer and industrialization differ depending on the socio-economic and cultural settings. Theoretical frameworks such as the "Knowledge Spillover" Theory and the "Triple Helix" Model of innovation emphasize the importance of collaboration and knowledge exchange among academia, industry and government. The models suggest that fostering partnerships across sectors is crucial for innovation-driven growth. In comparison, the present study provides empirical evidence of authorship patterns in IKM.

Limitations of the study

There are several limitations to be acknowledged in this study as follows:

i. One of the limitations is primarily to rely on articles from a specific set of peer-reviewed journals indexed by AJOL. This approach might have excluded valuable insights from non-peer-reviewed sources and grey literature potentially limiting the comprehensiveness of the analysis. Expanding further research to include a broader array of publications, both peer-reviewed and non-peer-reviewed, could provide a more diverse understanding of authorship patterns in IKM in Tanzania.

ii. The study focused predominantly on bibliometric analysis revealing trends in authorship, and collaboration. However, the bibliometric analysis did not probe into the motivations behind the authorship patterns. Further research could employ qualitative approaches such as interviews or surveys with authors, to explore the institutional, social and cultural factors influencing authorship patterns. Case studies of specific indigenous knowledge systems and how they are documented or managed could offer valuable context to the quantitative findings, to explore the underlying factors influencing collaboration dynamics.

iii. Investigating how authorship patterns impact IKM and 4th IR in Tanzania offers useful insights into optimizing IKM for national development. Furthermore, institutional incentives, access to research funding and

academic recognition frameworks may also influence the current trend of single-authorship dominance as found in the present study. Investigating these factors could provide deeper insights into why collaborative authorships remain low. Longitudinal studies tracking changes in authorship and collaboration over time, particularly as Tanzania continues to integrate 4th IR, would offer a more dynamic understanding of how these patterns evolve in response to shifting technological and academic environments.

RecommendationsConsidering the findings of the study, the following key recommendations are proposed to enhance collaborative authorship and knowledge-sharing in the field of IKM landscape in Tanzania:

i. Investigation on models of collaborative authorships that encourage co-authorship between academics, IK stakeholders and practitioners is recommended. For instance, studies that examine successful interdisciplinary partnerships could offer practical insights into creating more inclusive and collaborative research environments involving case studies of projects that integrate IK with modern scientific frameworks, ensuring that indigenous voices are not sidelined in academic discourse.
ii. Exploring the contribution of IK to specific economic sectors such as agriculture, healthcare and environmental management to understand how IK is an enabler in examining the intersection between indigenous practices and 4th IR for sustainable industrial growth is also commendable.
iii. Preparing a detailed analysis of authorship productivity in IKM is crucial, considering factors such as institutional support, funding and academic recognition to provide insights into the barriers to co-authorship as critical for promoting collaborative practices.
iv. Exploring how University policies, funding agencies, or publishing frameworks either incentivize or discourage collaborative authorships, particularly in interdisciplinary fields like IKM.
v. Investigating effective knowledge-sharing platforms including open-access journals, community forums, and digital platforms that prioritize inclusive participation to cater for both academic and non-academic audiences to bridge the gap between research and practices.

vi. Preparing strategies for disseminating research findings in accessible formats such as policy briefs, community workshops, or multimedia content to enhance the impact of IKM research on local and national development.
vii. Conducting longitudinal studies to monitor changes in authorship patterns and collaboration over time.
viii. Understanding how 4th IR influences collaborative authorships of IK to foster innovation and industrialization.
ix. Encouraging co-authorship between researchers from different regions and disciplines, academic institutions and IK stakeholders is crucial for the cross-pollination of innovations.
x. Universities and research institutions should establish incentives that reward inter-disciplinary and regional collaboration.
xi. Publishers should assess the geographical origins of their articles regularly and actively promote their journals in underrepresented regions.
xii. Establishing exchange programmes with other regional and international journals to increase the visibility of Tanzanian publications.
xiii. Funding agencies should prioritise funding studies that demonstrates significant regional and institutional collaboration.
xiv. Co-authored publications should be recognised and rewarded for fostering a research culture that values collective intellectual contributions over individual efforts.
xv. Stakeholders concerned should provide a more comprehensive understanding of the national landscape of scholarly publishing to uncover trends specific to different disciplines or regions, providing deeper insights into improving collaboration and knowledge-sharing,
a. including longitudinal analyses to track authorship patterns and collaboration changes over time to understand the long-term trends of transformations brought about by the 4th IR.

Conclusion

This study has shed light on the critical role of collaborative authorships, knowledge-sharing and transfer in advancing IKM in the context of the 4th IR. The findings of the study underscore the dominance of single authorship in scholarly publications, with limited collaboration among authors from different geographic regions. This limited co-authorship suggests that knowledge-sharing

practices may not fully leverage the potential of interdisciplinary collaboration essential for fostering innovation and inclusive development. The geographical concentration of research outputs, predominantly from the north-western region, further illustrates a significant disparity in the national distribution of scholarly activity. Such regional imbalances limit the diversity of perspectives in IKM and hinder efforts towards broader national integration. Therefore, the reliance on IK and the preference for English-language publications highlight the importance of integrating local knowledge with global academic standards, promoting the visibility and influence of IK in global discourse ensuring that Tanzania's unique cultural assets contribute to its industrialisation and knowledge economy. Finally, a more inclusive and collaborative approach to IK research outputs will enrich academic discourse and ensure that the country's diverse IK systems are for sustainable development.

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Bibliometric Analysis of Artificial Intelligence in Library Services: Research Trends and Insights

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Abstract

This study examined the transformative role of artificial intelligence (AI) in library services through a bibliometric review of existing research trends. A systematic search in the Scopus database was conducted to identify AI-related papers on library services published in English from 1987 up to March 2024. The key bibliometric indicators which are publication output, citation analysis, and co-citation networks, were analyzed using the VOS viewer application. The study methodology and analysis concentrated on English-language journal articles and conference papers that examined the application of AI technologies in library services, and operations, highlighting AI's increasing significance in the field. By excluding book chapters and standalone books, researchers were able to focus on the most pertinent studies, ultimately resulting in a dataset of 973 relevant papers for bibliometric analysis. The findings of the study revealed a gradual increase in publication trends from 1987 to 2024 showing an increase in research on artificial intelligence (AI) in library services, with annual publications rising from 20 before 2007 to over 140 publications in 2023, particularly after a significant surge in 2017. The United States leads in both publications (296) and citations (4,905), followed by China (151) and India (76), revealing disparities in contributions and suggesting barriers for India in citation impact. Co-citation analysis positions the U.S. as a central hub for international collaborations, notably with countries like South Korea and Japan, while also highlighting expanding networks in African nations. Furthermore, cluster analysis underscores the interconnectedness of topics like "libraries," "metadata," and "knowledge-based systems," reflecting AI's transformative role in library operations. However, the study's reliance on the Scopus database limits its scope by excluding relevant research from other databases and non-English publications.

Keywords: *Artificial intelligence, Machine learning, Library services, Library operations, AI technologies, Chatbots, libraries.*

Introduction

Artificial Intelligence (AI) has become an increasingly prominent and transformative force across numerous industries and domains (Bawack, Wamba, Carillo & Akter, 2022; Guo, Hao, Zhao, Gong, & Yang, 2020). From healthcare to finance, AI is revolutionizing the way organizations operate and deliver services

to their clients. The library and information science field has not been left behind in this rapidly changing technological landscape (Massis, 2018; Omame & Alex-Nmecha, 2020); this includes intelligent chatbots, recommendation engines, automated cataloguing and discovery tools. This advanced technology is poised to reshape and enhance how libraries interact with and serve their patrons (Okunlaya, Syed Abdullah & Alias, 2022). Libraries, often viewed as traditional institutions, have demonstrated a keen ability to adapt and integrate cutting-edge innovations like AI to improve their offerings and stay relevant in the digital age (Omame & Alex-Nmecha, 2020). The integration of AI technologies has significantly enhanced various aspects of library operations, including user assistance, collection development and information retrieval (Ajakaye, 2022; Gundakanal & Kaddipujar, 2019; Oyelude, 2021). One of the most exciting AI applications in libraries is the implementation of intelligent chatbots and virtual assistants (Nawaz & Saldeen, 2020). These conversational AI agents can engage with library users in natural language, providing real-time reference and information services. Additionally, AI-powered algorithms can automatically generate metadata for library materials, streamlining the cataloguing and indexing process (Affum & Dwomoh, 2023; Gundakanal & Kaddipujar, 2019; Massis, 2018). This automated metadata generation not only improves the discoverability of library resources but also frees up librarians' time, allowing them to focus on higher-value tasks (Omame & Alex-Nmecha, 2020). Furthermore, AI-driven analytics and predictive models can support data-informed decision-making in collection management and strategic planning (Anumula, Anumula, Anumula & Damerla, 2024; Iwu-James, Haliso & Ifijeh, 2020; Oyelude, 2021; Pence, 2022). Overall, the adoption of AI technologies in libraries has empowered librarians to deliver more efficient, personalized and user-centric services, ultimately enhancing the overall library experience for patrons.

AI in the library involves the utilization of AI-based methods, systems, tools, or algorithms to support and enhance various library operations and services (Ajakaye, 2022; Bakiri, Mbembati & Tinabo, 2023; Barsha & Munshi, 2023; Mwandosya, 2022; Mwilongo & Mwageni, 2022). For several decades, researchers have investigated the implications and applications of AI technology within the context of library services and operations. However, the understanding of AI in libraries is not as extensive as the rapid growth of AI. The lack of rigorous analysis of AI in libraries poses a challenge for researchers to know the extent to which research related to AI in libraries has been conducted and what research gaps it addresses. Conducting research on AI in libraries is crucial as it will provide

valuable information, insights, and direction for the integration and application of AI technology in library operations and services. Such research efforts can offer an in-depth understanding of the capabilities, limitations, and challenges associated with using AI in various library activities. Therefore, this study aimed to analyze the existing research on the application of AI in libraries and provide direction for further research in this area.

The main objective of this study was to present a holistic perspective on library-related AI research as well as to identify potential future directions that could benefit librarians and library patrons. Through an extensive, globally scoped review of the literature on AI in libraries, this analysis sought to examine the AI-focused research targeting library services. This analysis serves as a vital resource for researchers, providing an overview of the AI field in the library context, which will help inform and guide the development of further library-oriented AI studies. Furthermore, this analysis serves as a crucial reference for those less familiar with this domain, but who are interested in exploring the applications of AI in library services.

Methodology

This study conducted a systematic search in the Scopus database to identify all research papers published in English on the topic of AI in library services, from 1987 to March 2024. The search strategy was designed based on bibliometric indicators to screen the titles for eligibility, with the abstracts and full texts being reviewed as needed. The key bibliometric indicators utilized in these studies were publication output, citation analysis and co-citation networks. The analysis of these indicators was performed using the VOS viewer software. Through this software, the researcher gathered and analyzed the relevant AI-related literature focused on library services.

The initial literature review identified relevant search keywords covering AI technologies, library services and libraries. These keywords were then combined using Boolean operators to construct a comprehensive search string that was used to obtain the results. The search string included the following components: TI=("artificial intelligence") OR TI=("data learning") OR TI=("machine learning") OR ("intelligent agents") OR TI ("AI applications") OR TI=("expert systems") OR TI=("fuzzy logic") OR TI=("computer vision") OR TI=("automatic programming") OR TI=("speech understanding") OR TI=("autonomous robots") OR TI=("Smart Systems") OR TI= ("automated

metadata generation") OR TI=("intelligent agents") OR TI=(chatbots) OR TI=("voice recognition") OR TI=("text mining") OR TI=("robotics) AND (TS=(library) OR TS=("library service") OR TS=("library collections ") OR TS=("library operations") OR TS=("library resource discovery") OR TS= ("library services")).

This comprehensive search approach helped to ensure that relevant literature on the application of AI technologies in the context of library services and operations was identified and included in the review. The search conducted on 17th August 2024, in the Scopus database retrieved 20,513 papers published from 1987 to 2024.

Screening and searching process

The screening process for this analysis focused on English-language journal articles and conference papers relating to the use of AI technologies in libraries, library services and operations. This deliberate choice reflects the growing importance of AI in the library field. The screening included peer-reviewed articles and conference papers but excluded book chapters and books, allowing a researcher to capture the most relevant and impactful research at the intersection of AI and library/information science.

The study began with a pilot screening process to refine the bibliometric methodology. The researcher established initial search criteria, which are relevant keywords, subject areas, publication types and date ranges. A preliminary search in the Scopus database gauged the volume and relevance of results. Based on this assessment, the researcher iteratively refined the search strategy by adjusting keywords, filters and parameters to ensure the comprehensiveness and accuracy of the findings. Additionally, a random sample of 50 papers from the pilot search results was manually screened against predetermined inclusion and exclusion criteria. This exercise identified gaps in the screening process and estimated the time and resources needed for full-scale screening. Ultimately, 31 out of the 50 papers were removed as they were deemed unrelated to AI in library services.

The final search was conducted on 17th July, 2024, yielding 20,513 results. From these, 19,540 publication papers were excluded due to lack of relevance to library services and AI, non-English language and irrelevant formats. This rigorous process resulted in a data set of 973 relevant papers for the subsequent bibliometric analysis.

Data analysis process

Bibliometrics review is the study of literature used to identify developmental trends in a given field (Shaikh *et al.*, 2023). This type of study helps to understand how a specific field is growing and changing by looking at a number of publications, topics being researched, source of research and journals which are publishing them. The study also looks at trends, like which topics are popular over time.

This study looked at the growth of research on AI and library services by analyzing the number of publications from 1987 to 2024. The study focused on newspapers published in each year. It also examined citation trends and identified the top 10 countries with high citation rates on AI in library services. Moreover, the study highlighted the main topics and keywords in these publications.

Results

Distribution of publications on artificial intelligence (AI) and library services

The first objective of this study was to assess publication trends on AI and libraries. This was important because it provides a comprehensive understanding of how AI applications in libraries have evolved**.** The results revealed gradual annual publication trends related to artificial intelligence and library services as indexed by Scopus from 1987 to 2024. The findings in Figure 1 illustrate the trends of changes:

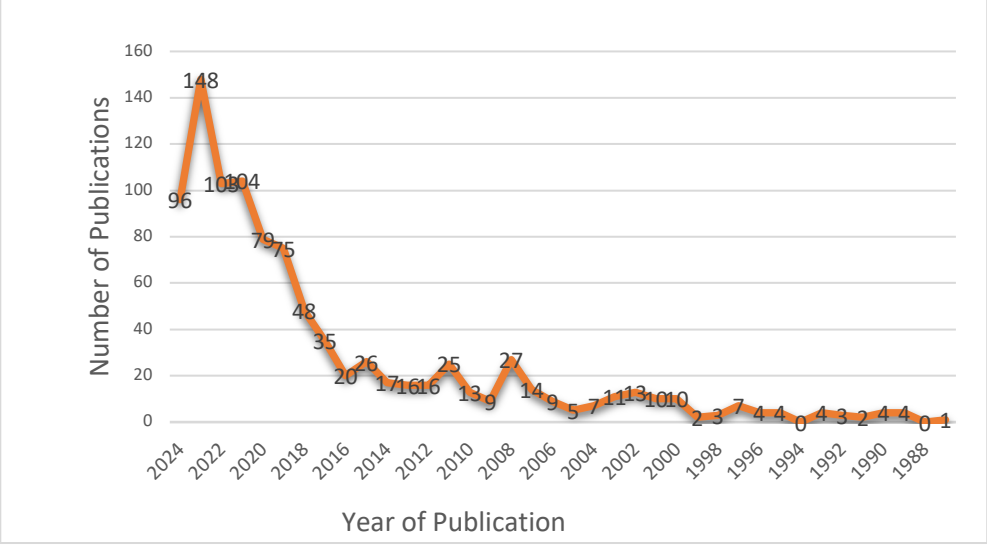

Figure 1: Distribution of Publications per Year

The findings in Figure 1 reveal significant trends in the publications related to artificial intelligence (AI) and library services, as indexed by Scopus from 1987 to 2024. Initially, the publication numbers were low, remaining below 20 annually from 1987 to 2007, indicating minimal research activity in this area. This low numbers of publication may reflect a lack of integration between AI technologies and library practices, as well as limited awareness of AI's potential benefits (Iwu-James *et al.*, 2020).

From 2008 to 2016, there was a gradual increase in publications. This may be suggesting a growing recognition of the AI in enhancing library services. This slightly increase of these publications could be influenced by advancements in AI technologies and an increasing number of studies exploring their application in information management (Noh, 2015).

A substantial shift occurred around 2017, when the volume of publications began to rise more sharply, culminating in a notable spike in 2023, with over 140 publications. This surge reflects a growing academic interest and investment in the field, and this could possibly be driven by the increasing importance of digital transformation in libraries and the need for innovative solutions to enhance user experiences (Affum & Dwomoh, 2023; Ajakaye, 2022; Anumula *et al.*, 2024; Pence, 2022). The rise in publications during this period aligns with broader trends in the adoption of AI technologies across various sectors, emphasizing the critical role of libraries in adapting to these changes (Liu *et al.,* 2021).

Overall, the data suggests a significant evolution in the use of AI in the library landscape and it becomes an integral part of research and practice. The expectation of continued high levels of publication in the coming years indicates that libraries are increasingly prioritizing the integration of AI technologies to improve services and address contemporary challenges in information management (Oyelude, 2021).

Publication trends by country

The study also assesses publication trends by country, which is crucial for understanding the global landscape of AI technology in libraries. By analyzing trends across different countries, the study identified leading nations in AI research and application, as well as regions that may be lagging. This geographical analysis helps highlight disparities in technological adoption and innovation,

providing insights into the factors driving or hindering progress in various parts of the world. Such information is valuable for fostering international collaboration, sharing best practices, and ensuring that advancements in AI benefit libraries globally.

The findings in Figure 2 illustrate the number of publications by country, revealing significant disparities in research contributions. Thus, in this context, the United States leads with 296 publications, indicating its dominant position in the field. Also, China with 151 publications, reflecting its growing in research. India, with 76 publications, demonstrates an increasing engagement, while European countries like the United Kingdom (68) and Germany (65) also show strong contributions. Italy (42), Canada (47), France (31) and Spain (36) have lower outputs, with Singapore at the bottom with just 26 publications. Overall, these findings highlight the competitive landscape of research, particularly among the top contributors, which may shape future collaborations and research priorities.

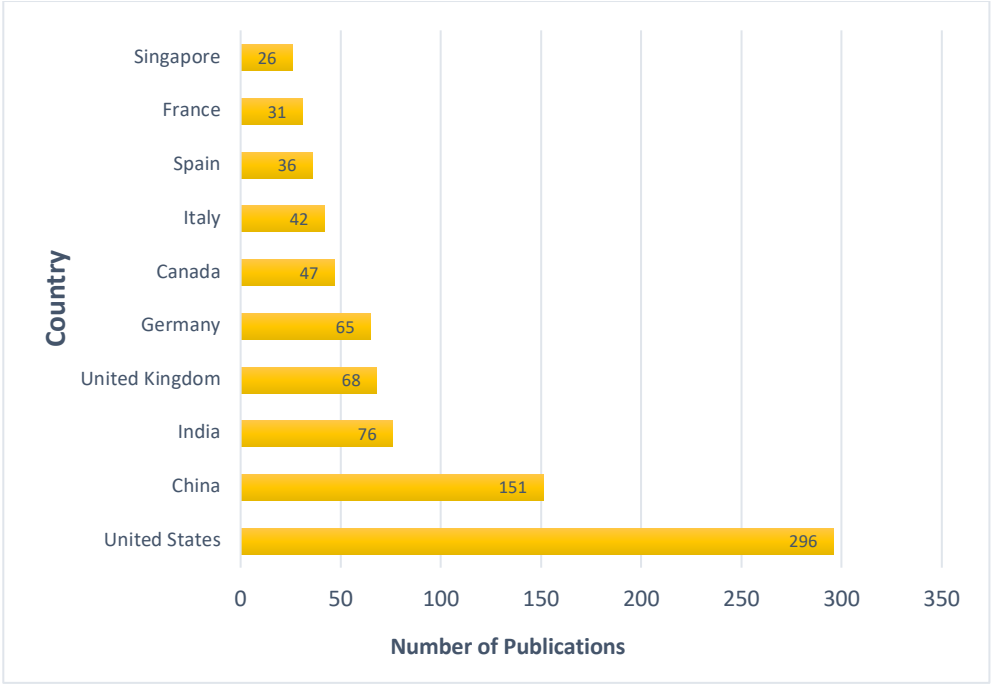

Figure 2: Publication Trends by Country

The findings on publications by country reveal significant alignment with findings in previous studies in the field. The United States is leading with 296 publications which is consistent with earlier research indicating its dominant role in global scientific output. This could be attributed to substantial funding, advanced research infrastructures and a strong emphasis on innovation (National Science Foundation, 2021). As Figure 2 depicts, other countries like China, Italy, Canada, France and Spain have a notable contribution to the publications on AI technologies and library services.

However, the findings indicate a low number of publications in middle- and low-income countries, raising concerns given that these nations typically face limited library resources and services, along with the barriers that AI technologies aim to address. This limited research output may hinder the development and implementation of AI solutions tailored to their specific needs, perpetuating inequalities in access to information and technology. Furthermore, the limited research in middle and low-income countries can result in a disconnect between global advancements in AI and the unique challenges facing these countries, such as inadequate infrastructures, limited funding and insufficient training for library staff (Diseiye, Ukubeyinje, Oladokun & Kakwagh, 2024). Addressing these gaps is crucial for ensuring that AI technologies effectively enhance library services and support equitable access to information in all regions.

Number of citations

This study also analyzed the number of citations. Analyzing the number of citations is a key aspect of assessing publication trends. Citations indicate the impact and influence of research in the academic community. Through examining citation counts, the study identifies the most influential works and authors in the field of AI and libraries. This helps track citation trends over time and reveals shifts in research focus and emerging areas of interest. Understanding citation patterns also aids in recognizing leading researchers and institutions, fostering collaboration and guiding future research efforts.

The findings reveal that the United States leads significantly with 296 publications and 4,905 citations, underscoring its dominant role in research. It is followed by China with 151 publications and 1,788 citations, indicating its growing influence in the field. Other countries like Germany contributes 65 publications and 1,071 citations, while the United Kingdom has 68 publications and 1,318 citations,

showcasing their strong research outputs. Canada reports 47 publications and 596 citations and Australia has 25 publications and 634 citations. In addition, Spain contributes 36 publications and 814 citations, while India contributes 76 publications and 424 citations. Overall, this data highlights the varying levels of research activity and impact, with the United States markedly ahead in both publications and citations.

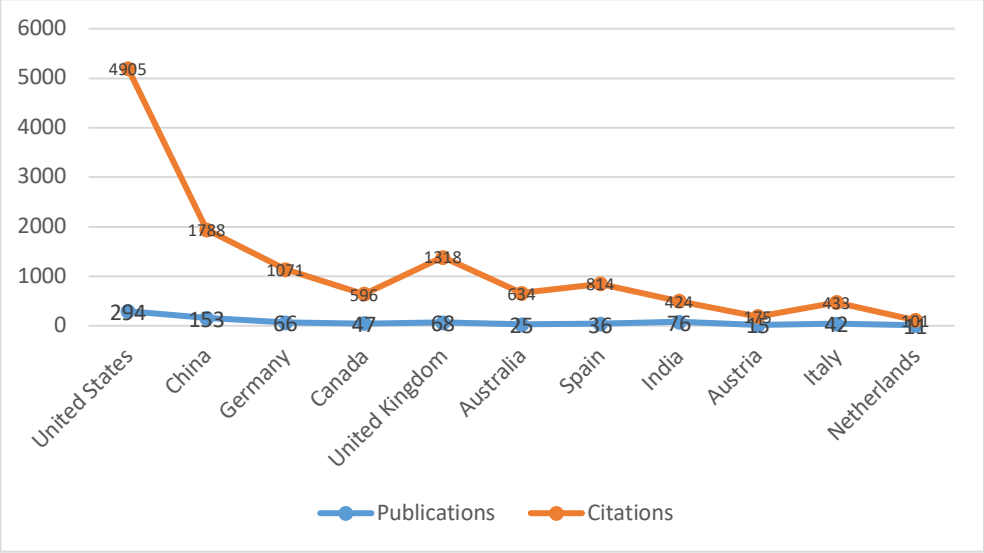

Figure 3: Number of Citations

The findings in Figure 3 highlight the United States' significant lead in research output, with 296 publications and 4,905 citations, reaffirming findings from previous studies which show that the U.S consistently ranks high in global research. This dominance is attributed to substantial investment in research and development as well as a robust academic infrastructure (National Science Foundation, 2021). The U.S leads not only in quantity but also in citation impact, indicating it is widely recognized in research. Other developed countries like China, Italy, Canada, France and Spain also have large numbers of citations, due to their possession of a good number of publications.

However, despite its relatively low citation count, India (76 publications, 424 citations) demonstrates a growing trend in research output, particularly among emerging economies. These findings align with the observations of Singh *et al* (2021) who noted that while India has significantly increased its publication

numbers, it continues to face challenges in achieving comparable citation impact. This discrepancy could be attributed to factors such as limited access to international journals and insufficient collaboration networks (Nielsen & Andersen, 2021).

Overall, these findings support existing literature on global research dynamics, emphasizing the competitive nature of academic output and the importance of international collaborations. As countries strive to enhance their research capabilities, the data suggests a potential shift in research priorities and partnerships, particularly as nations like China and India continue to expand their presence in the global research landscape.

Co-citations

The study conducted a co-citation analysis to explore authors' collaborative networks in AI and library services. Network visualization highlights the collaborative landscape of research. The findings of the study highlighted the United States connecting with 14 countries and reflecting its leadership in the field. Among these connections, South Korea stands out, indicating a robust collaborative relationship. Significant partnerships are also evident with Japan and the Russian Federation. Additionally, several European countries, including Hungary, Portugal, Finland and Poland demonstrate intra-European collaboration.

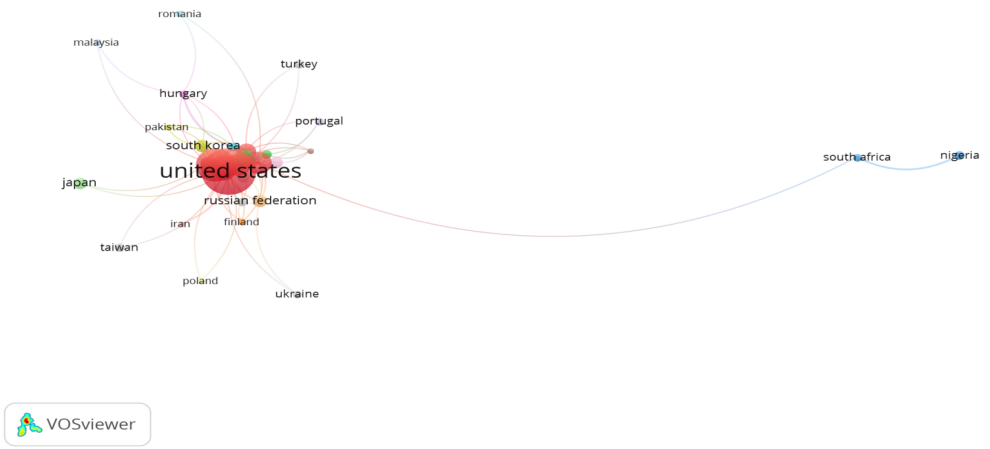

Figure 4: Co-citation Analysis

The findings of the study illustrate intra-European collaboration trends in this field; this includes the collaboration among Hungary, Portugal, Finland and Poland. Prior research has shown that European nations often collaborate to enhance their research capabilities, driven by the European Union's framework for fostering scientific cooperation (European Commission, 2020).

Notably, the findings reveal that authors from Africa, particularly Nigeria and South Africa, appear on the periphery of the collaborative network, suggesting an expanding web of global connections. This positioning indicates their increasing involvement in international research collaborations, which may enhance their visibility and influence in the global academic community. As these countries strengthen their research capabilities, they are likely to cultivate partnerships that facilitate the sharing of knowledge and resources, ultimately addressing local challenges with global insights. Furthermore, this trend highlights a growing recognition of the importance of African perspectives in the discourse surrounding AI and library services, paving the way for innovative solutions that are both culturally relevant and contextually appropriate. This aligns with findings that highlight the increasing role of African researchers in global scientific discourse, as they seek to establish partnerships that enhance their research visibility and impact (Adeleke, 2021).

Cluster analysis of artificial intelligence and library services publications

The study also conducted cluster visualization. This was done aiming at identifying the study hotspot and potential opportunities for collaboration. The findings of the study highlight the interconnectedness of key topics related to libraries, artificial intelligence (AI) or machine learning, with "libraries" at the centre. Surrounding this central theme are significant concepts such as "artificial intelligence," which is linked to terms like "metadata," "knowledge-based systems," and "information services," illustrating the transformative impact of AI on library operations. Additionally, "machine learning" emerges prominently, featuring keywords like "learning algorithms," "decision trees," and "performance computing," indicating active research into the application of these techniques in library contexts. Other relevant themes, including "electronic publishing," "information use," and "education," showcase the broad applications of technology in enhancing library services and user engagement. Overall, this visualization underscores the growing convergence of libraries with AI and

machine learning, highlighting the potential for innovation and improved services in the field. See the summary of the findings in Figure 5:

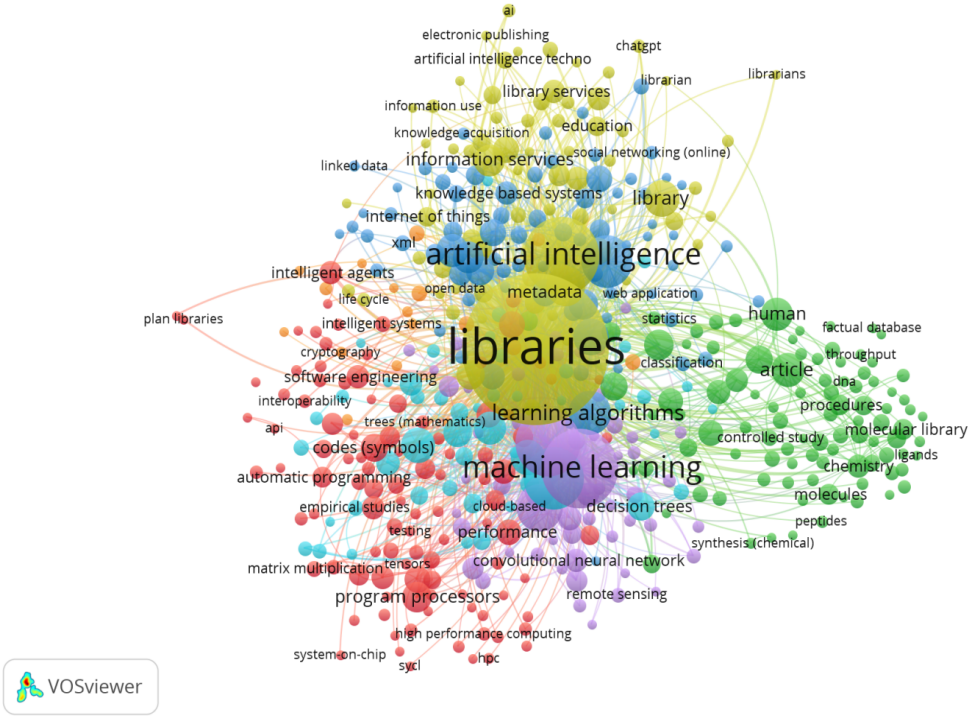

Figure 5: Cluster Analysis of Artificial Intelligence and Library Services Key Topics

The cluster visualization reveals a rich interconnectedness of key topics surrounding libraries, artificial intelligence (AI) and machine learning, with "libraries" positioned at the centre. This central theme emphasizes the evolving role of libraries as they integrate advanced technologies into their operations. The presence of "artificial intelligence" as a significant concept illustrates its transformative impact, linked to terms such as "metadata," "knowledge-based systems," and "information services." This suggests that AI is not only enhancing cataloguing and retrieval processes but also improving user experiences and operational efficiencies in libraries (Ajani, Tella, Salawu & Abdullahi, 2022).

Machine learning emerges prominently within the visualization, highlighting keywords like "learning algorithms," "decision trees," and "performance

computing." These terms indicate active research focused on applying machine learning techniques to optimize library services, such as personalized recommendations and automated data analysis (Liu *et al*., 2021). The integration of these technologies reflects a broader trend in the library field toward leveraging data analytics for enhanced decision-making and user engagement.

Other relevant themes, namely "electronic publishing," "information use" and "education" further showcase the diverse applications of technology in libraries. This aligns with existing literature that emphasizes the importance of digital literacy and the role of libraries in facilitating access to electronic resources and educational materials (Wang *et al*., 2022).

Overall, this visualization highlights the growing convergence of libraries with AI and machine learning, highlighting the potential for innovation and improved services. As libraries continue to adapt to technological advancements, they are positioned to play a crucial role in shaping the future of information access and management.

Limitations of the study

The limitations of this study include the reliance on the Scopus database, which provides only a subset of available publications. Further research should consider exploring additional databases such as Web of Science, Dimensions and others to uncover a broader range of relevant papers. Additionally, this study did not encompass books and publications in other languages. Thus, studies in other languages ignoring English, should also be studied or incorporated.

Conclusion

In conclusion, this study highlights the significant trends and collaborative dynamics in research related to libraries, artificial intelligence and machine learning. The analysis of publication trends from 1987 to 2024 reveals a gradual increase in research on artificial intelligence in library services. Initially, from 1987 to 2007, annual publications remained low; a slight rise occurred between 2008 and 2016, reflecting growing recognition of AI in the library field. However, a significant surge began in 2017, culminating in over 140 publications in 2023, indicating heightened interest and investment in the field. The United States leads with 296 publications, followed by China (151) and India (76), highlighting notable disparities in contributions. The U.S not only leads in publications but

also with 4,905 citations underscoring the influential nature of its research. Conversely, India, despite an increase in publications, demonstrates a lower citation impact, suggesting barriers to access to international journals.

Co-citation analysis shows the U.S as a central hub in international research collaborations, connecting with 14 countries, including strong ties with South Korea and Japan. Intra-European collaborations are also evident, while African nations like Nigeria and South Africa are expanding their research networks. The cluster analysis highlights the interconnectedness of key topics, with "libraries" at the centre, linked to AI concepts such as "metadata" and "knowledge-based systems," indicating AI's transformative impact on library operations.

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Development of an AI Metadata Extraction Model to Enhance Electronic Resources Indexing in Academic Libraries

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Abstract
The objective of this study was to create an AI model for extracting metadata from electronic resources, improve academic library indexing, utilize Natural Language Processing techniques, and assess its performance. Data for the study was collected from three selected higher learning institutions, namely DUCE, MUHAS and NM-AIST. These academic institutions use KOHA, an open-source integrated library system that supports library management and bibliometric analysis. A bibliographic metadata of 8,421 records covering the period from 2010 to 2022 was extracted from these institutions. Among them, 79% were books, 12% were open access journal articles and other online resources, and 9% were dissertations and theses. An Ensemble Learning Model was developed which leveraged k-means clustering and natural language processing (NLP). Features captured in clustering included ISBN, barcode number, publication year, authors, publishers, titles, keywords, location and call number. Sentiment Analyzer (SA) was used to extract sentiments from online articles. SA detected all references to the given subject and determined sentiment in each of the references using NLP techniques. In this study, an Ensemble Learning Model was used as a meta-learning approach to leverage the strengths of both models and build a more robust and accurate metadata extraction model. F1-score of 0.72 was obtained for the evaluation matrix which combined two matrices: Precision and Recall, into a single metric by taking their harmonic mean. In simple terms, the F1 score was the weighted average mean of Precision and Recall used in Natural Language Processing. The Ensemble Model significantly improves the accuracy of extracting bibliographic indexed resources in digital libraries using relevant search queries. This indicates that the model has a high precision in extracting relevant indexed electronic resources.

Keywords: *Metadata, artificial intelligence (AI), bibliometrics, digital library, OPAC, natural language processing (NLP), smart library*

Introduction

In today's digital age, academic libraries play a pivotal role in facilitating access to vast electronic resources, including scholarly articles, research papers and digital collections. However, the efficient management and accessibility of this wealth of information have become increasingly complex (Gul & Bano, 2019). Technological advancements have affected academic libraries and compelled them to enhance the value of their information services (Hamad *et al.*, 2023). To address this challenge, academic libraries are turning to Artificial Intelligence (AI) for innovative solutions.

The AI models developed represent a groundbreaking advancement in the realm of academic libraries globally. These models harness the power of machine learning (ML) and natural language processing (NLP) to automatically extract essential metadata from digital resources, such as titles, authors, keywords and publication dates.

The increasing relevance of AI in innovation is witnessed by the publication of several studies on topics such as AI-supporting innovation analytics (Kakatkar *et al.*, 2020). This automated process not only saves valuable time and resources for library staff but also ensures the accuracy and consistency of metadata, which is important for effective resource indexing and retrieval. In particular, libraries can preserve, conserve, access and retrieve information in a friendly and sophisticated manner (Mwilongo & Mwageni, 2023).

Additionally, in this era of information abundance, academic libraries must keep pace with the ever-expanding digital landscape. The increasing enrolment of students and demand for flexible content delivery modalities for higher education calls for an urgent digital transformation in academia particularly in library services (Lwoga & Sukums, 2018). In response to these pressures, metadata extraction models offer a scalable and adaptable solution, enabling libraries to efficiently organize, catalog and enhance the discoverability of electronic resources. By streamlining metadata generation, these models can significantly improve the management of digital collections. This development holds the promise of revolutionizing the way academic libraries manage their collections, ultimately benefiting researchers, students and educators by providing seamless access to the wealth of knowledge contained within these digital repositories.

Artificial Intelligence models analyze text content, identify key metadata elements (e.g., authors, titles, keywords and publication dates), and extract this information accurately and efficiently from a wide range of digital resources. By automating metadata extraction, academic libraries enhance resource discovery for users (Koperwas *et al.*, 2017). Accurate metadata enables better search and retrieval of digital materials, making it easier for researchers and students to find relevant information (Majhi & Mukherjee, 2023).

Smart Libraries in Tanzania

Some universities and educational institutions in Tanzania are increasingly focusing on building smart library systems. Libraries in these institutions have been working hard to digitize academic resources to enhance access to education and research materials (Mtebe & Raisamo, 2014). These libraries often integrate digital collections, e-resources and library management systems for that purpose. The use of AI for cataloging, searching and recommending resources to users, particularly in the form of automated catalog management, will assist students and researchers in quickly finding the resources they need.

Artificial Intelligence (AI) applications in libraries

Natural Language Processing (NLP) as an AI technology has been applied in libraries globally, to help users interact with the system more naturally, supporting queries in local languages, and making information more accessible (Khurana *et al.*, 2023). Libraries can deploy AI models to recommend academic articles, books and other resources based on the preferences and past behaviours of users, improving personalized learning. Ajani (2024) suggests that AI can assist in digitizing and preserving historical texts, manuscripts and other cultural documents, contributing to knowledge preservation.

Educational and research initiatives

There are several studies that have highlighted the increasing establishment of international collaborations between Tanzanian universities and global technology institutions aimed at integrating AI-driven solutions in library management and education. These partnerships signify a comprehensive initiative to align library services with modern educational and research needs, ensuring that AI technologies support knowledge access, digital literacy and academic innovation. To maximize the potential advantages of AI in education while reducing potential risks, it is important to participate in meaningful and thorough talks with all stakeholders (Mambile & Mwogosi, 2024). Integration of AI into

smart libraries is part of a broader trend in enhancing educational infrastructure and improving knowledge accessibility through technological advancement.

Justification of the study

Academic libraries play a fundamental role in preserving intellectual information by serving as repositories that house a wide range of electronic materials such as research papers, journals and digital archives. Nevertheless, the effective administration and accessibility of these resources present noteworthy obstacles. Big Data applications and systems are built to respond to these emerging challenges (Simović, 2018). The increase in electronic materials necessitates streamlined indexing and cataloging processes to ensure that users can access relevant information quickly and effectively.

The adoption of Artificial Intelligence (AI) and Natural Language Processing (NLP) in smart libraries presents significant opportunities but also comes with several challenges, in Tanzania and other developing countries. Academic libraries in these countries face challenges due to unreliable internet connectivity, limited digital infrastructure and a lack of modern technologies (Sukums *et al*., 2023). Furthermore, rapid expansion of digital resources has resulted in a state of excessive information, commonly referred to as information overload (Bawden & Robison, 2020). In particular, digital libraries provide distinct issues for representation and retrieval, rendering them an optimal setting for exploring the application of bibliometric and NLP techniques to enhance discovery and retrieval (Mayr *et al*., 2018).

Developing and integrating NLP models, with OPAC requires significant investment in hardware, software and training. Libraries, especially in underfunded institutions, may struggle to find the financial resources to implement these solutions (Lynch *et al*., 2021). AI tools need to be seamlessly integrated with existing library systems, which may not always be compatible with new technologies. Furthermore, AI algorithms may exhibit biases, especially if they are trained on non-representative data. The use of AI to digitize and make accessible large quantities of written material may raise copyright and intellectual property concerns, especially when scanning and distributing older or rare texts (Menell *et al*., 2023).

Academic libraries lack a robust digitization strategy to create digital versions of local content, limiting the amount of information AI algorithms can process (Cox,

2023). Without adequate digitized resources, NLP models in academic libraries may not function optimally. Moreover, success of academic libraries depends on their ability to provide easy and timely access to electronic resources (Jaillant, 2022). Inadequate metadata and indexing hinder resource discoverability, resulting in frustration for library users and reduced utilization of valuable digital collections. Moreover, theses and dissertations are often not published in an established venue and are hence absent from the usual channels of communication of the research front, more so in journal-oriented fields, whereas in book-oriented fields, publication of theses through scholarly publishers is common (Donner, 2021).

To address such challenges, this model will leverage artificial intelligence techniques, including natural language processing and machine learning, to automatically extract and enhance metadata from electronic resources. However, the development, implementation and integration of such AI models into academic library systems present technical and practical obstacles.

According to Mwandosya (2022), in the domain of library and information science, particularly in relation to search databases like the Online Public Access Catalogue (OPAC), indexing serves as the fundamental process for discovering documents. The objective of the index is to enhance the accuracy of obtaining specific sections of the pertinent documents and to minimize the percentage of recalls and associated files obtained in libraries. The integration of the NLP model with OPAC will allow users to interact with library systems in natural and everyday language, making searches more intuitive. Instead of using complex Boolean queries or specific keywords, users can ask questions or describe the information they are looking for in conversational language (Dalton *et al*., 2022). NLP enables semantic search, where the system understands the meaning behind a user's query rather than just matching exact keywords. This leads to more accurate and relevant results, helping researchers and students quickly find the information they need.

The indexing of electronic resources can enhance various aspects of library services, such as cataloguing, classification, recommendation, reference, discovery and preservation. Furthermore, this technological advancement will assist librarians in the automation of metadata production and extraction processes, hence enhancing the overall quality and uniformity of bibliographic entries (Ullah *et al*., 2018). The model that will be constructed will also assist librarians in

addressing intricate and varied inquiries using natural language processing and semantic analysis techniques. Additionally, this model will assist librarians in identifying novels and developing subjects, trends and patterns within the realm of information, employing techniques such as data mining and machine learning.

Objectives

a) To develop an AI model for extracting metadata from a wide range of electronic resources;
b) To enhance the indexing of electronic resources by automating metadata extraction;
c) To implement NLP techniques for text-based resources to extract metadata elements.

Literature review

Librarians need to prepare for the future of AI in library services by educating themselves and their stakeholders about the basics and implications of AI, such as its capabilities and risks (Cox *et al*., 2019). It is also important to engage with clients and users of AI to understand their needs, expectations, feedback and concerns. Moreover, librarians should test the tools and technologies of AI to explore their capabilities and limitations (Kuleto *et al*., 2021). Logically, information services provider like the university library is a good environment where AI can add value to upcoming university education (Okunlaya *et al*., 2022).

Academic libraries are flooded with a massive volume of digital resources. Manual cataloging and indexing of these materials are time-consuming and error-prone, leading to incomplete or inaccurate metadata. This hinders users' ability to find and access the resources they need for research and learning. Jha (2023) argues that one of the technologies that is rapidly advancing and changing is AI. This technology can be leveraged to enhance cataloging and indexing of the library materials, thereby mitigating the challenges associated with the manual handling of these materials. Cox (2019) added that librarians needed to become more skillful at educating clients on how AI is used in library services and what it means for information searching and browsing.

Additionally, users should evaluate the outcomes and impacts of AI with regards to performance, quality, relevance, diversity, accessibility, usability and satisfaction. Librarians should also stay up to date on the new and emerging applications, challenges, opportunities and innovations of AI in order to adapt

their skills and strategies accordingly (Dwivedi *et al*., 2021). The incorporation of AI is exerting a significant influence on various domains and sectors, including library services. Gasparini and Kautonen (2022) also argued how AI will have impact on the way research libraries operate and provide their services, as well as how they will make use of many types of data that they save in their repositories in the future.

With the widespread availability of extensive, complete text databases, both the fields of Information Retrieval (IR) and bibliometrics have also benefited from advancements in natural language processing (NLP) and computational linguistics. These technologies are designed to employ diverse and efficient methods to support the educational process at the college and university level (Alhawiti, 2014). These methods have enhanced the retrieval of documents and the capacity to investigate connections among entities of interest in metrics research (Wolfram, 2016).

The deployment of an AI metadata extraction has promise for augmenting the efficiency, accuracy, and relevance of librarians in disseminating information and providing resources to academics, students and other stakeholders (Sa'ari *et al*., 2023). When AI is applied to the field of library and information science, more specifically, to search databases such as the Online Public Access Catalogue (OPAC), indexing is the basis of document retrieval. The purpose of the index is to improve the precision of retrieving parts of the relevant documents and to reduce the proportion of recalls and related files retrieved in libraries (Mwandosya, 2022).

Scholars have conducted investigations into the potential of AI technology to revolutionize different facets of library operations, including cataloguing, resource finding and user services (Subaveerapandiyan, 2023). Numerous scholarly investigations have been conducted to explore the impact of AI implementation on the development of novel services within library settings. This encompasses the enhancement of user experiences through the use of advanced resource indexing, and intelligent recommendation systems. Voogt *et al* (2013) argue that an important area of impact is likely to be in search/resource discovery. These studies highlight the importance of accurate and automated information extraction to improve the indexing and discoverability of resources. According to Huang (2022) artificial intelligence (AI) has a notable impact on enhancing the acquisition and instruction of information literacy.

The current manual cataloguing and indexing procedures demonstrate inefficiency in managing the substantial volume of library resources, necessitating the use of automated alternatives (Places *et al*., 2016). Natural Language Processing (NLP) undertakes a significant role in enhancing the functionality and user experience of academic smart libraries, as these libraries evolve into digital and AI-driven ecosystems. NLP models can analyze user behavior, reading patterns, and preferences to make personalized recommendations for books, articles or research papers (Sarma *et al*., 2021). This personalization enhances the user experience by making the library's vast collection more manageable and tailored to individual needs.

Moreover, the notion of information literacy assumes a pivotal significance within the realm of artificial intelligence, as it underscores the imperative for individuals to possess a feeling of agency and self-regulation. Ideally, these systems are equipped with the capacity to perform tasks, develop conclusion based on past experiences, and produce predictions by processing and analyzing large amounts of data (Yoon *et al*., 2022). Consequently, AI models have the potential to enhance the process of uncovering pertinent and personalized information. The identification of obstacles and possibilities in the implementation of AI-driven metadata extraction methods has been undertaken by researchers (Lee, 2013). The obstacles that may arise encompass issues related to data quality, model accuracy and ethical considerations as suggested by Qin (2014).

Scholarly investigations have been undertaken to perform comprehensive literature evaluations to assess and delineate the body of research that intersects AI with library services (Massis, 2018). The aforementioned review offers valuable insights pertaining to the present state of AI implementation in libraries, as well as its consequential effects on diverse facets of library operations. In view of the current literature, it can be argued that academic libraries are increasingly adopting technology-oriented approaches, to streamline processes and enhance services. The literature discusses the importance of AI in the context of research libraries and its potential to enhance electronic resource retrieval.

Materials and methods

A total of 8,421 bibliographic metadata records were extracted from the selected higher education institutions. These datasets were extracted from the libraries at Dar es Salaam University College of Education (DUCE), Muhimbili University

of Health and Allied Sciences (MUHAS) and Nelson Mandela African Institution of Science and Technology (NM-AIST). The publication distribution consisted of 79% books, 12% open access articles and other online resources and 9% dissertations and theses, covering the time span from 2010 to 2022. The selected academic institutions employ KOHA, an open-source integrated library system designed to facilitate library administration and bibliometric analysis and an Online Public Access Catalogue (OPAC). OPAC is a database used in libraries to make cataloged materials publicly accessible online. Users search the OPAC for books, articles and other materials by keywords or other details such as author and title. The system helps library users in these institutions to locate books they are looking for and provide them with bibliographic information about such materials.

NLP encompasses several components such as speech synthesis, machine translation, linguistic models, information retrieval, information extraction and speech recognition (Adejo & Misau, 2021). A novel Ensemble Learning Model was constructed by combining k-means clustering with NLP (Balyan *et al.*, 2017). Using the technique of multiple-text summarization, it was possible to cut down the amount of time and efforts required to read the entire document by selecting the most important aspects from the original texts. The clustering process comprised the following features: ISBN, barcode number, publication year, authors, publisher, title, key words and call number.

These features acted as metadata fields extracted by NLP techniques which were Named Entity Recognition (NER) and Text Classification. The Sentiment Analyzer utility was employed to extract sentiment from web articles. The systematic analysis identified all mentions of the specified topic and assessed the sentiment in each reference using natural language processing methods. An Ensemble Learning Model was employed as a meta-learning strategy to exploit the respective advantages of both models. The objective was to construct a metadata extraction model that is both more resilient and precise. Cleaning and preprocessing the dataset involved text normalization, removing stop words and handling special characters. Shahzad and Khan (2023) mentioned that the data should be in a suitable format for an AI model training. Unsupervised machine learning was utilized to develop AI metadata extraction model that enhanced electronic resource indexing. As a first step in the extraction process, the conversion from PDF into HTML format is performed. The choice to convert PDF format into HTML was made because this format preserves the formatting

information during conversion (Kovačević *et al.*, 2011). This information is crucial for the recognition of metadata. After the conversion process, feature extraction is performed for each text row on the first page (Figure 1). At this stage, it was critical to define the features or attributes that are relevant for metadata extraction (Mariani *et al.*, 2023). These features include text content, document structure and metadata tags. Both clustering and dimensionality reduction unsupervised learning methods were applied to extract relevant features from electronic resources (Virkus & Garoufallou, 2020). This involved identifying key patterns, text segments and metadata elements within the content.

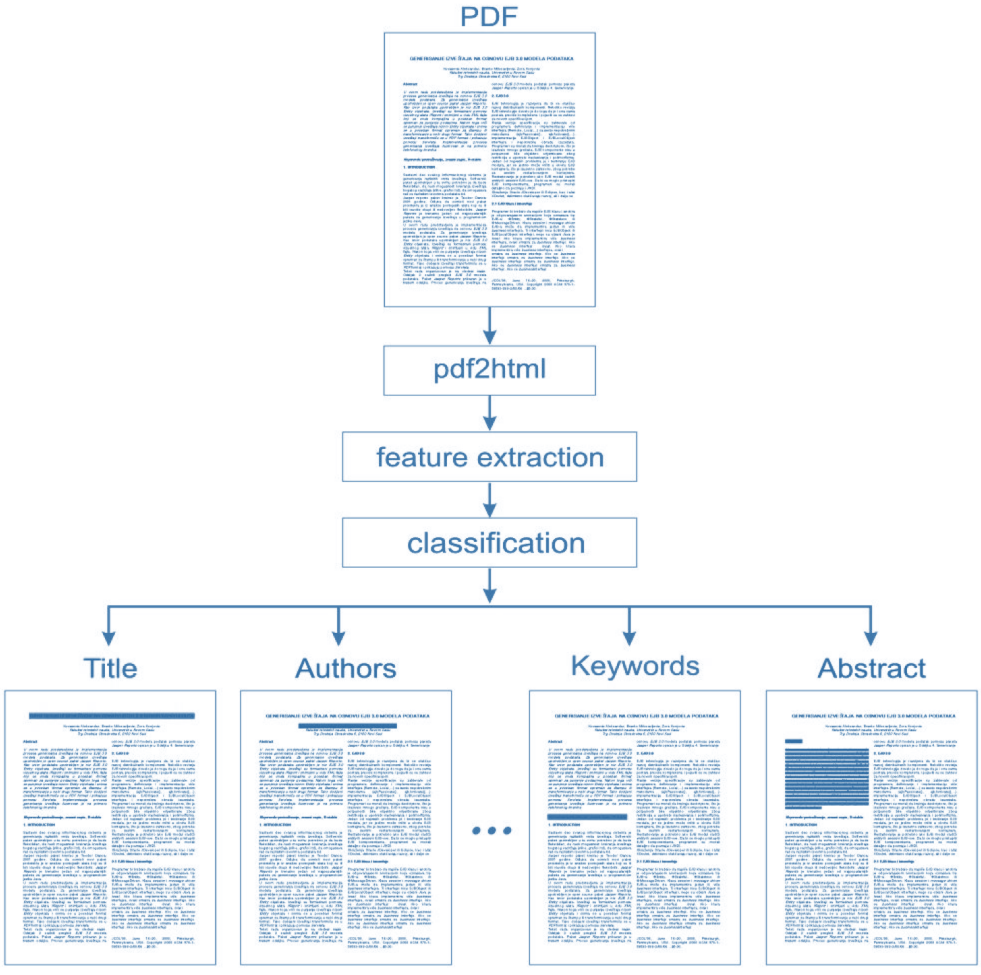

Figure 1: Metadata Extraction Process
Source: Kovačević *et al* (2011)

Unsupervised machine learning allows for scalability, as it can handle large volumes of electronic resources efficiently, making it suitable for academic libraries with extensive digital collections. Choosing an appropriate combination of AI models for metadata extraction was a key aspect (Nguyen *et al.*, 2019). Natural Language Processing (NLP) method was used to process textual content and identify metadata elements like author names, titles, abstracts, keywords and citations.

A critical evaluation metric in Natural Language Processing (NLP) tasks is the F1-score (Bashir *et al.*, 2021). To assess the accuracy and effectiveness of the model, there is a needed of balancing between Precision and Recall. This metric combined these two components into a single number by taking their harmonic mean, making it a more informative measure than considering Precision or Recall alone. These measures enhance the model's ability to precisely extract and categorize metadata (including titles, authors, keywords, publication dates, and subjects) from electronic resources (Kovačević *et al.*, 2011).

The precision metric indicated how many of the positive predictions made by the model were actually correct. It measured the accuracy of the positive class. The recall metric, on the other hand, measured how many of the actual positive instances were correctly identified by the model.

The F1-score served as a balanced metric that took both Precision and Recall into account. It provided a more holistic measure by using the harmonic mean of Precision and Recall. The harmonic mean was used instead of the arithmetic mean because it corrects extreme values.

Techniques like Named Entity Recognition (NER) and part-of-speech tagging assisted in this process. Thereafter, training the selected classification model on the preprocessed dataset was done; 80% of the data was used for training, 10% of the data was used for testing the model and the remaining 10% was reserved for validation to evaluate the model's performance.

The model's performance was assessed in terms of metadata extraction accuracy, precision, recall, and F1-score. The model was fine-tuned as needed based on the evaluation results. The final stage was to develop a web-based application that integrates the trained model into the academic library's indexing process while ensuring compatibility with the library's indexing workflow. Therefore, it

automatically processes new electronic resources, extracting metadata and populating indexing databases.

Results and discussions

An overall F1-score of 0.72 was obtained for the evaluation matrix which combined two matrices: Precision and Recall, into a single metric by taking their harmonic mean. The F1-score was the weighted average mean of Precision and Recall used in Natural Language Processing as given in Table 1. Recall measured the proportion of actual metadata entries that the model successfully identified. It focused on how well the model captured all the relevant information present in the data. This score reflects a **strong but improvable** model for metadata extraction. True Positives (TP): These were cases where the model correctly identified the metadata field. For example, correctly extracting "Frank John" as the author of a paper. False Positives (FP): These were cases where the model incorrectly predicted a metadata field, assigning wrong or irrelevant information. For instance, predicting the wrong author for a paper. False Negatives (FN): These were cases where the model failed to identify a metadata field that was present. For example, if an author's name is in the document but the model fails to extract it, it counts as a False Negative.

The model automated a significant portion of the indexing process, though improvements are needed to reduce errors and enhance precision and recall. With further optimization, the model will greatly enhance the discoverability and accessibility of electronic resources. In the current state, it still offers substantial benefits by increasing the efficiency of cataloging tasks but requires human review for critical tasks or important resources.

Codes were written in Python-based Jupyter notebook which allowed execution within notebook documents. Given the limited computing resources, data was imported into Colab notebooks. Colab is a hosted Jupyter Notebook service that requires no local setup to use and provides online access to computing resources, including GPUs and TPUs. Colab notebooks allow the combination of executable codes and rich text in a single document (Cunha *et al*., 2021). Additionally, it was possible to harness the full power of other Python libraries to analyze and visualize data. Numpy was used to generate random data during fine-tuning, and Matplotlib was used for visualization.

Table 1: Precision, recall and F1-scores

Metadata Field	Precision	Recall	F1-score
Authors	78.87	77.91	78.39
Barcode Number	74.80	71.52	73.12
Call Number	71.78	71.25	71.51
ISBN	69.44	69.93	69.69
Keywords	78.36	77.86	78.11
Publisher	72.88	72.40	72.64
Title	74.51	57.05	64.62
Year of Publication	72.08	66.02	68.91

As shown in Table 1, the eight metadata fields used included Authors, Barcode number, call number, ISBN, keywords, Publisher, Title and Year of Publication. From Table 1, the highest performance was achieved for Author accounting for 78.39%, followed by Keywords (78.11%), then Barcode number (73.12%). While the Title field had a high Precision of 74.51%, it had F1-score of 64.62% due to a higher False Negative (FN) rate which affected the Recall to 57.05%.

A correlation matrix was also used to show correlation coefficients between variables. A correlation matrix is used to summarize data, as input into a more advanced analysis, and as a diagnostic for advanced analyses (Jiang, 2019). Each cell in the table shows the correlation between two variables. Findings as demonstrated in **Figure 2 show the Authors and Call Number** fields exhibiting a very strong positive correlation (0.99). This indicates that as the value for one of these fields increases, the value for the other field also increases in a nearly identical manner. This might indicate that specific authors are often associated with particular call numbers (subject areas).

The fields **Authors and Keywords** show a negative correlation; this suggests that certain authors are inversely related to the presence of certain keywords. For example, an increase in the representation of some authors may correspond to a decrease in the presence of specific keywords, indicating divergence in thematic focus.

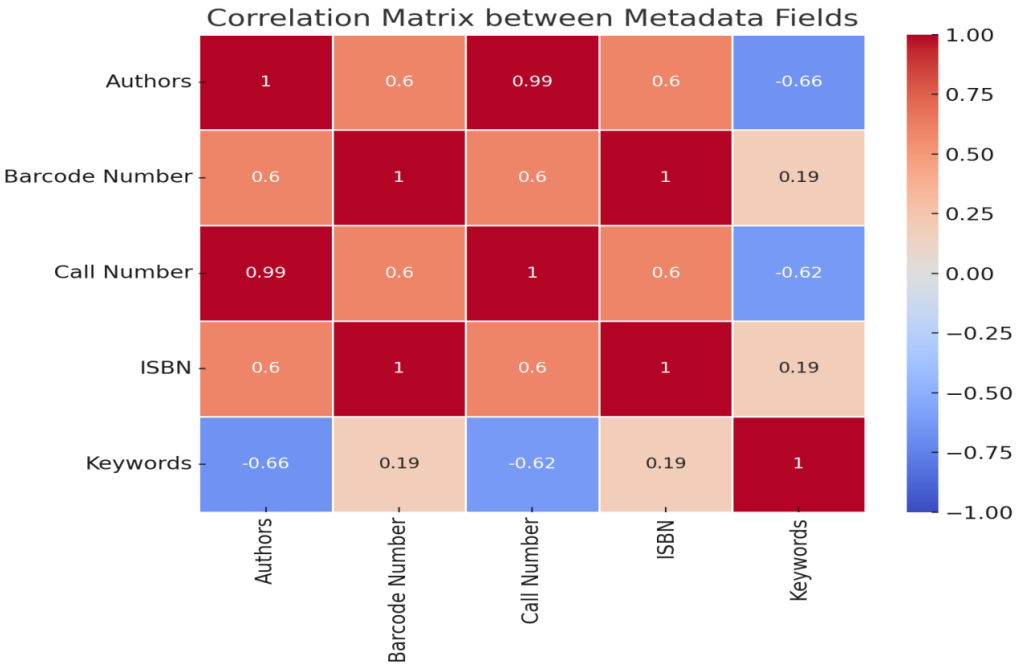

Figure 2: Correlation Matrix

The **ISBN** field has moderate positive correlations with **Barcode Number** (1.0) and other fields such as **Authors** (0.6) and **Call Number** (0.6). The perfect correlation with **Barcode Number** could suggest that these two fields are closely tied (each book has a unique barcode and ISBN). Ke**ywords** tend to show weak to moderate negative correlations with most other fields, except for a weak positive correlation (0.19) with **ISBN** and **Barcode Number**. This suggests that keywords did not strongly align with the other metadata fields and reflected unique thematic aspects of the dataset. In this instance, an extended matrix was used to correlate a wider selection of the fields. Figure 3 shows a strong positive correlation of 93% between **Keywords** and **Publisher**, indicating that certain keywords are more likely to appear in publications from specific publishers. This suggests that publishers have a thematic focus reflected in the keywords used.

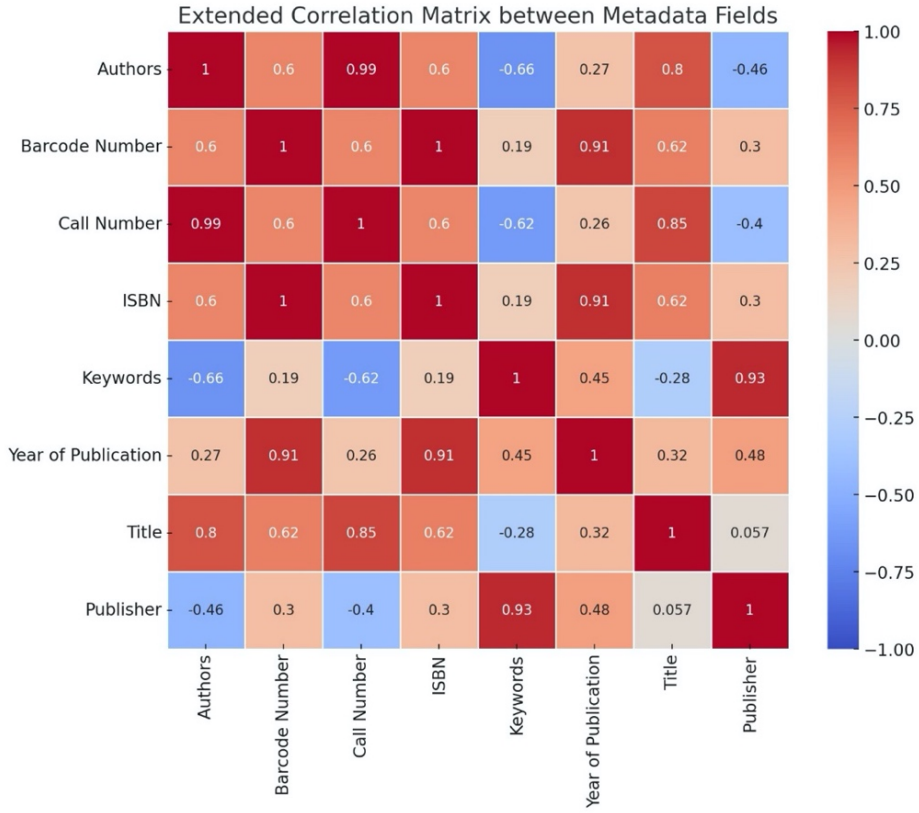

Figure 3: Extended Correlation Matrix

The correlation between Authors and Call Number remains very strong at 99%. This suggests that particular authors are closely tied to specific call numbers (likely representing particular subject areas). On the contrary, there is a negative correlation between some of the fields such as Authors and Publishers, suggesting that certain publishers may not frequently publish works by specific authors or that authors are associated with different publishing patterns. Year of Publication shows a strong positive correlation with Barcode Number (91%) and ISBN (91%). This reflects a pattern where more recent publications have higher barcode and ISBN numbers. Call Number and Title show a strong positive correlation (0.85), meaning that the titles and call numbers are closely related. This suggests a structured classification system for the titles in relation to call numbers. Publisher and Keywords have a strong positive correlation of 93%, showing that certain publishers tend to use specific sets of keywords more frequently. This could indicate thematic specialization and targeted publications. Overall, the

strong correlation between Call Number and Title can be used to further analyze how books are classified within a library's subject areas while the negative correlations between Keywords and fields like Authors and Call Number indicate gaps in thematic coverage and differences in how metadata fields are assigned to electronic resources.

The box plots based on the correlation matrix data is shown in Figure 4. These plots depict the distribution of correlation values across the eight metadata fields. Given correlation values typically range from -1 to 1. The box plots reflect this range:

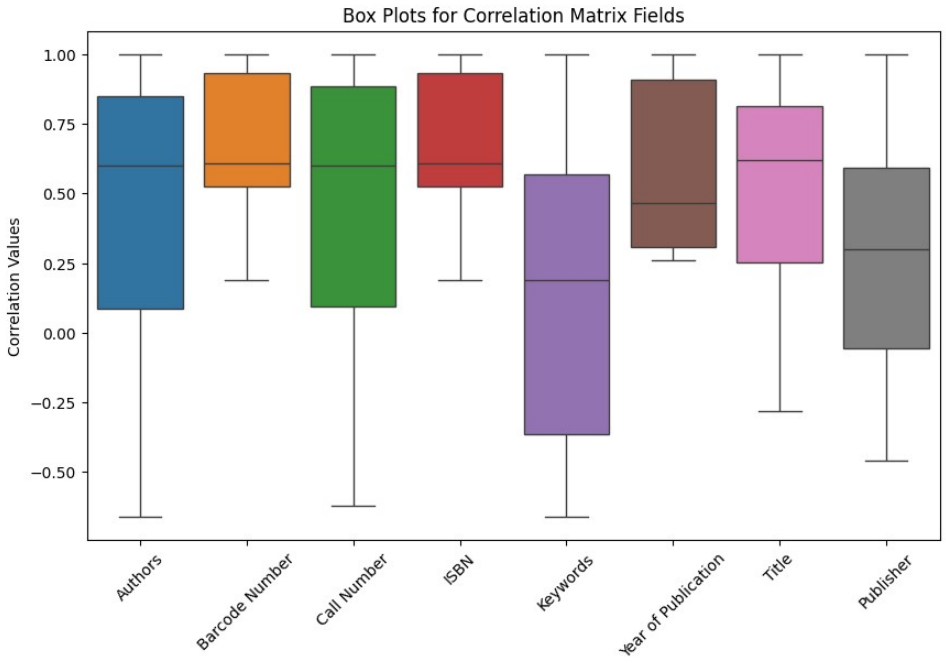

Figure 4: Box Plots for Correlation Matrix Fields

Findings, as illustrated in Figure 4, show that the correlations involving **Authors** are generally positive and tightly distributed between around 0.5 and 1.0. The median correlation is high, suggesting a strong relationship with most of the other fields. The **Barcode Number** field has a wider spread, with correlations ranging from around 0.2 to 1. The median is closer to 0.6, indicating moderate correlations with other fields, though the spread suggests variability in how **Barcode Number** correlates with others. Like **Authors, Call Number** has a high median correlation, with values mostly positive and concentrated in the 0.6 –1 range.

ISBN follows a similar pattern to **Barcode Number** with moderate correlations. The median is close to 0.6, showing a balanced relationship with other fields. The distribution of correlation values is more spread out, with some values dropping below 0. This suggests that **Year of Publication** does not have a strong positive correlation with all other fields. There may be both positive and negative relationships with other metadata fields**.** The **Title** has a wider spread, with lower correlation values compared to the other fields. This suggests that **Title** might have weaker relationships with other metadata fields, especially compared to **Authors** or **Call Number**. **Publisher** has a mix of positive and negative correlations like **Keywords**. The spread indicates some variability in how this field correlates with the other fields.

Conclusion

The present study has unveiled the considerable capacity of Artificial Intelligence, namely Natural Language Processing (NLP) and machine learning (ML) methods, in the automation and enhancement of metadata extraction precision. By utilizing AI, academic libraries may greatly decrease the need for human cataloguing, attain greater levels of accuracy in resource indexing, and guarantee that digital collections are readily accessible to users.

The use of **Natural Language Processing (NLP)** in Tanzanian academic libraries will offer significant potential to transform how students and researchers' access, interact with and manage academic resources. However, challenges such as **limited infrastructure, lack of data** and **human capacity** remain to be addressed to fully realize these benefits. With targeted investment and collaborative efforts, Tanzanian academic libraries will harness the power of NLP to enhance academic research, improve resource accessibility, and preserve local knowledge for future generations.

Moreover, the incorporation of such artificial intelligence models in academic libraries guarantees that libraries maintain pace with the rapid expansion of digital content. Given the growing dependence of academic institutions on electronic resources, the need for efficient indexing becomes paramount to effectively manage extensive repositories and facilitate prompt and correct access to pertinent information for students, researchers, and teachers. Nevertheless, the effectiveness of an AI-driven method depends on other important factors

including having access to rigorous training data, strong infrastructure, and ongoing enhancements to the AI model.

Ultimately, the use of artificial intelligence in extracting metadata for academic libraries will provide a novel and readily expandable resolution to the difficulties brought about by the digital era. AI-driven metadata extraction model, when continuously refined, developed in collaboration with subject specialists, and allocated with sufficient computing resources, will have the capacity to transform the management and indexing of digital collections in academic libraries. This transformation would result in increased accessibility, improved research capabilities, and better academic results.

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Mapping the Landscape of Research Data Management Publications in East Africa: A Bibliometric Analysis

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Abstract

Research data management (RDM) has gained popularity in East Africa. Despite its growth, the publication landscape remains unclear. This study maps the RDM publication landscape in East Africa. Specifically, the study establishes trends and country-wise contribution of RDM publications and types of RDM publications, identifies sources used to produce RDM publications, analyses the RDM citation distribution, and establishes the keyword analysis used in RDM publications. Four countries of the East African region with the highest number of data sets in the Data Citation Index were purposively selected. The advanced features of the Scopus bibliographic database were used to harvest RDM publications. Using Scopus, RDM publications were retrieved, capturing publication year, country affiliation, document type, and citation count. Findings indicate a growing RDM research trend but a low citation distribution. The study concludes that RDM is an emerging library and information science specialisation that contributes to knowledge and inspires further research.

Keywords: *Research data management, RDM, bibliometric analysis, citation pattern, publishing trends.*

Introduction

In today's rapidly evolving world, RDM has increasingly become significant. Its significance is evident in all critical sectors such as primary, secondary, tertiary, quaternary and quinary (Garidzirai *et al.*, 2019). It is also essential in service provision, scientific research, policy development and fostering innovations (Jiskani *et al.*, 2019; Mosha & Ngulube, 2023a). Research data refers to any information (facts), qualitative or quantitative, collected, observed, generated or created through scientific research (Kwanya, 2021). Dorcas, Glenrose, Ibinaiye and Tijani (2023) claim that research data are essential for future uses and should be preserved. Researchers primarily use research data to interpret, describe and understand the phenomenon (Adika & Kwanya, 2020; Mosha & Ngulube, 2023a). For the research to be well administered and reused in the future, it has to be

managed through the practice known as research data management (RDM) (Adika & Kwanya, 2020; Kwanya, 2021). RDM refers to the process of administering research data throughout their lifecycle, from planning, production, selection, evaluation, storage and processing to their use and reuse (Buhomoli & Muneja, 2023b; Franke *et al*., 2018; Mosha & Ngulube, 2023a). RDM aims to gather, capture, store, track and archive all the data being produced in scientific projects and experiments (Buhomoli & Muneja, 2023b; Heuer, 2020; Kwanya, 2021; Mosha & Ngulube, 2023a). It also refers to the all-encompassing term used to describe the processes and activities related to the creation, storage, security, preservation, retrieval, reuse and sharing of research data (Buhomoli & Muneja, 2023b; Kwanya, 2021). RDM, among other things, makes research data useful and reusable in the future (Heuer, 2020). The well-managed research data also increases the transparency of research and eliminates the duplication of data collection efforts but also can lead to the validation of research findings (Adika & Kwanya, 2020; Franke *et al*., 2018; Mosha & Ngulube, 2023b).

The RDM practices are in different phases of maturity worldwide, with developed countries being more mature than developing countries (Gupta *et al*., 2021; Onyancha, 2016; Shah *et al*., 2024). To support this, Naseema and Sevukan (2022) indicated that, though developing countries have now started to invest a lot in research projects by dedicating enormous amounts of money, time and other resources, they have poor strategies for maintaining research data. This view is also supported by Mushi *et al* (2020) in their studies on identifying RDM services conducted at the University of Dodoma in Tanzania. Buhomoli and Muneja (2022), in their study on research data handling in Tanzania, affirmed this stance.

Globally, RDM practices have grown and have become a critical focus for research among the scholarly community, driven by the emphasis on open science and transparency in research (David *et al*., 2022; Khan et al., 2023). This has significantly increased the volume of RDM publications over time. This growth in the volume of RDM publications is supported by the improved RDM infrastructures and policy developments, especially in high-income countries (Boyd, 2021; Buhomoli & Muneja, 2023a; Rod *et al*., 2023). The United States is leading in many RDM publications, primarily influenced by its significant research funding, extensive research infrastructures and a strong emphasis on open science (Khan *et al*., 2023; Wyk, 2018). Other leaders in RDM publications are the United

Kingdom, Netherlands, Australia, Germany and Canada (Wyk, 2018). In Africa, the status of RDM publications indicates that the field is still emerging (Buhomoli & Onyancha, 2024). Therefore, the volume of RDM publications is relatively low compared to other regions like North America and Europe, with South Africa leading in practices and publications (Buhomoli & Onyancha, 2024; Onyancha, 2016). South Africa hosts several research repositories and has been proactive in RDM practices (Buhomoli & Onyancha, 2024; Wyk, 2018). East Africa, just like other regions, is making some progress towards the incubation of RDM practices and RDM publications (Adika & Kwanya, 2020; Kakai *et al*., 2018; Mosha & Ngulube, 2023b).

Despite the vital importance of RDM, there is a limited understanding of how RDM publications are evolving in East Africa. There is limited evidence of studies conducted in East Africa to map the RDM publications. The related research, such as that of Kwanya (2021), conducted in sub-Sahara Africa, focused on keyword analysis only and left aside other aspects such as trends analysis, citation distribution and publications sources. Other related studies such as those of Gupta *et al* (2021) and Shah *et al* (2024), concentrated on the global landscape and did not provide the detailed status of the RDM publications in the East Africa region. Moreover, there is insufficient evidence of comprehensive mapping of the volume, impacts and trends of RDM-related publications in East Africa. This, among other things, has limited the ability of East African institutions to develop effective RDM policies and strategies and the ability to assess the current state of RDM practices in the region. This also affected research institutions, researchers and policymakers' understanding of the direction and scope of RDM efforts in East Africa. Therefore, this study was conducted within this scope.

Purpose of the Study

This study aimed to map the landscape of RDM publications in East Africa using the Scopus database to inform RDM practices and strategies.

Research Questions

The following research questions guided the study:

a) What is the trend and country-wise contribution of RDM publications by East African countries?

b) What are the most dominant types of RDM publications published in East African countries?
c) What sources are used to produce the East African RDM publications?
d) What is the citation analysis of the RDM publications in East African countries?
e) What are most keywords used by RDM publications in East African countries?

Methodology

This study used a quantitative research approach, whereby the bibliometric analysis was employed to assess the RDM publication landscape in the selected East African countries. Four countries from the East African region with the higher number of data sets in the data citation index were purposively selected. These countries were Kenya, Rwanda, Tanzania and Uganda. The advanced features of the Scopus bibliographic database were used to harvest RDM publications. The Scopus database has a broader range of coverage; it provides detailed author profiles that help to access collaborative patterns. It also covers various document types and provides citation metrics. From the Scopus database, data were retrieved using the following search query: TITLE-ABS-KEY ("Research Data Management" OR RDM OR "Research Data" OR "Research Management" OR "Data Management" OR "data curation" OR "Data Archiving" OR "Open Data" OR "Data Stewardship" OR "Data Sharing" OR "Data Governance" OR "data reuse*" OR "data reutilization" OR "data Re*usage") AND TITLE-ABS-KEY (country name). The country names were replaced by the names of the selected East African countries, Kenya, Rwanda, Tanzania and Uganda, in the context of this study. Search results were then exported using the Scopus export feature. From the exported documents, the year of publication, document type, keywords and the number of citations were recorded. Data were refined by removing documents that were not related to RDM and those that appeared to be incomplete. MS Excel, Starta and the VOS Viewer were used to analyse the results.

Findings

This subsection presents the study's findings. It is organized according to the research questions.

Trends of RDM Publications and Country-wise Contribution

Results in Table 1 and Figure 1 indicate a growing trend in RDM publications, starting with a single publication from Kenya in 2007 and continuing to increase over time, with 2020, 2022 and 2023 recording the highest peak of RDM publications. Results further show that the selected East African countries contributed 113 publications since the first RDM publication was published in 2007. The study also noted that in the year 2007, there was a single RDM publication, then in 2008, there were no publications related to RDM. In 2009 there was also one publication and again in 2010, there were no RDM publications indexed in Scopus from the selected East African countries. Results show further that in 2011, East African countries published the RDM publications again, and there was a growing curve for three consecutive years, reaching 6 RDM publications in 2014. The study also recorded a rise and fall in the number of RDM publications, with the highest recorded numbers being 16 in 2020, 2022 and 2023. Regarding the country-wise contribution of RDM publications, Kenya was leading with 52 (46.02%) publications, followed by Tanzania with 28 (24.78%). Other countries and the results in general are summarized in Table 1 and Figure 1:

Table 1: Trends of the East African Countries RDM publications

Year	Kenya	Tanzania	Uganda	Rwanda	Total
2007	1	0	0	0	1
2009	1	0	0	0	1
2011	1	0	0	0	1
2012	1	1	0	0	2
2013	0	1	1	0	2
2014	6	0	0	0	6
2015	4	0	1	0	5
2016	2	1	0	1	4
2017	5	1	2	0	8
2018	4	3	1	0	8
2019	2	3	2	1	8
2020	6	4	4	2	16
2021	3	3	2	0	8
2022	10	2	4	0	16
2023	3	7	3	3	16
2024	3	2	5	1	11
Total	**52**	**28**	**25**	**8**	**113**
Percent	**46.02**	**24.78**	**22.12**	**7.08**	**100**

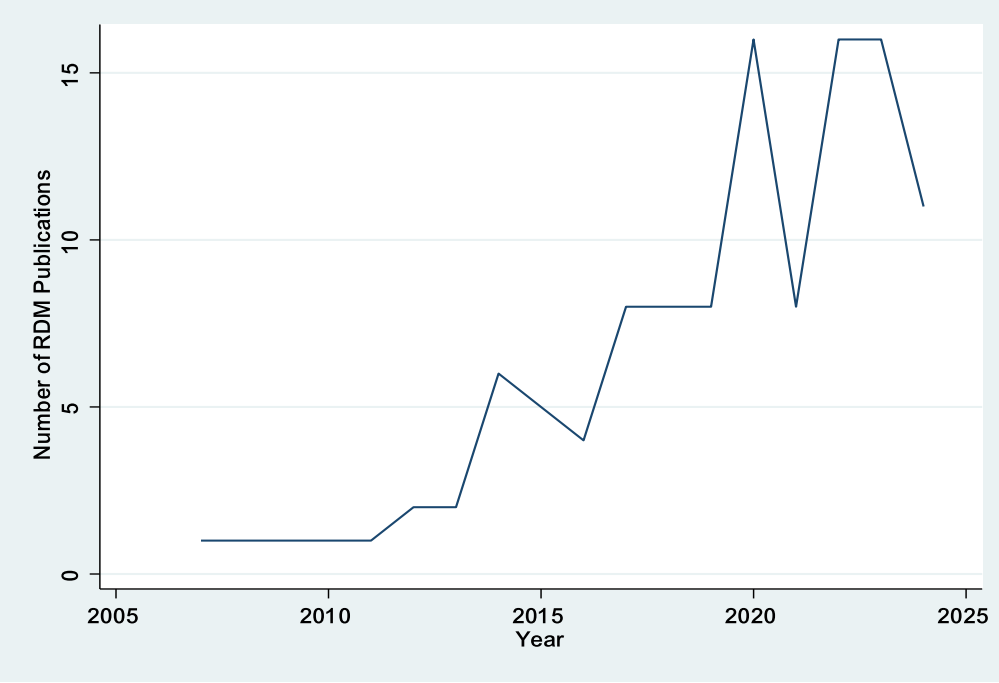

Figure 1: Distribution of Documents in Years

Document types of RDM publications published by East African Countries

The study shows that East African countries published various RDM document types. These document types include research articles (82, 72.56%), conference proceedings (28, 24.78%), and book chapters (3, 2.65%), as shown in Table 2. Results show further that most of these document types for each category emanated from Kenya. Please see Table 2 for the detailed results.

Table 2: Document Types of RDM Publications Published by East African Countries

Document Type	Kenya	Tanzania	Uganda	Rwanda	Total	Percent
Article	40	20	19	3	82	72.56
Conference paper	11	7	6	4	28	24.78
Book chapter	1	1	0	1	3	2.65
Total	**52**	**28**	**25**	**8**	**113**	**100**

Top Sources Producing RDM Publications in East African Countries

The findings show that 86 sources were used to produce RDM publications. The source that produced the highest number of publications produced 5 RDM publications. The detailed results are shown in Table 3:

Table 3: Distribution of Publications Across Various Sources

SN	Source Title	Frequency	Percent
1	ACM International Conference Proceedings	5	4.42
2	ELPUB 2020: Charting the Futures of Digital Publishing	4	3.54
3	International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences	4	3.54
4	BMC Pregnancy and Childbirth	3	2.65
5	BMC Research Notes	3	2.65
6	Library Management	3	2.65
7	Area	2	1.77
8	Bulletin of the World Health Organization	2	1.77
9	Data in Brief	2	1.77
10	East African Journal of Science, Technology and Innovation	2	1.77
11	Electronic Journal of Information Systems in Developing Countries	2	1.77
12	Information Discovery and Delivery	2	1.77
13	JAMIA Open	2	1.77
14	PLOS Global Public Health	2	1.77
15	Pan African Medical Journal	2	1.77
16	Sustainable Development Goals Series	2	1.77
17	Wellcome Open Research	2	1.77
18	2017 IST-Africa Week Conference (IST- Africa)	1	0.88
19	2018 IST-Africa Week Conference (IST – Africa)	1	0.88
20	2022 IST-Africa Conference (IST-Africa)	1	0.88
21	AMIA Annual Symposium proceedings	1	0.88
22	African Health Sciences	1	0.88
23	African Journal of Ecology	1	0.88
24	Annals of the Association of American	1	0.88
25	Applied Geography	1	0.88
26	Australian Journal of Crop Science	1	0.88
27	BMC Health Services Research	1	0.88
28	BMC Medical Informatics and Decision Making	1	0.88
29	BMJ Innovations	1	0.88
30	Conflict and Health	1	0.88
31	Critical Public Health	1	0.88
32	Data	1	0.88
33	Data Science Journal	1	0.88
34	Data and Information Management	1	0.88
35	Development (Basingstoke)	1	0.88
36	Digital Government: Research and Practice	1	0.88
37	Emerging Infectious Diseases	1	0.88
38	Engineering, Technology and Applied Science Research	1	0.88
39	Eurasian Mining	1	0.88

SN	Source Title	Frequency	Percent
40	Frontiers in Pharmacology	1	0.88
41	Frontiers in Public Health	1	0.88
42	Frontiers in Research Metrics and Analytics	1	0.88
43	Gates Open Research	1	0.88
44	Globalisation and Health	1	0.88
45	HEALTHINF 2021 - 14th International Conference on Health Informatics	1	0.88
46	Health Informatics Journal	1	0.88
47	IEEE AFRICON Conference	1	0.88
48	Information (Switzerland)	1	0.88
49	Information Development	1	0.88
50	Information Technology for Development	1	0.88
51	International Conference on Control, Automation and Systems (ICCAS)	1	0.88
52	International Geoscience and Remote Sensing Symposium	1	0.88
53	International Journal of Advanced Technology and Innovation Research	1	0.88
54	International Journal of Digital Earth	1	0.88
55	International Journal of Epidemiology	1	0.88
56	International Journal of Quality and Service Sciences	1	0.88
57	JMIR Public Health and Surveillance	1	0.88
58	Journal of Agricultural and Food Information	1	0.88
59	Journal of Cancer Policy	1	0.88
60	Journal of Global Health	1	0.88
61	Journal of Great Lakes Research	1	0.88
62	Journal of International Development	1	0.88
63	Journal of Librarianship and Information Science	1	0.88
64	Journal of Library Metadata	1	0.88
65	Journal of Map and Geography Libraries	1	0.88
66	Journal of Transport Geography	1	0.88
67	LIBER Quarterly	1	0.88
68	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	1	0.88
69	Lecture Notes in Networks and Systems	1	0.88
70	Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering	1	0.88
71	Open Data in Developing Economies: Toward Building an Evidence Base on What Works and How	1	0.88
72	PLoS ONE	1	0.88
73	Perspectives on Politics	1	0.88
74	Population Health Management	1	0.88

SN	Source Title	Frequency	Percent
75	Proceedings - 2016 2nd International Conference on Contemporary Computing and Informatics	1	0.88
76	Proceedings of the Association for Information Science and Technology	1	0.88
77	Proceedings of the Institution of Civil Engineers	1	0.88
78	Proceedings of the International Astronomical Union	1	0.88
79	Publishing Research Quarterly	1	0.88
80	Statistical Journal of the IAOS	1	0.88
81	TQM Journal	1	0.88
82	Tanzania Journal of Health Research	1	0.88
83	Transforming Government: People, Process and Policy	1	0.88
84	Water, Sanitation and Hygiene	1	0.88
85	Western Indian Ocean Journal of Marine Science	1	0.88
86	e-Journal of e-Democracy and Open Government	1	0.88
	Total	**113**	**100**

Citation Distribution

The findings indicate that RDM publications from East African countries had varying citation counts, ranging from 0 to 118 citations per document, as shown in Table 4. Results showed that the higher number of RDM publications (60) had 0 to 3 citation counts. More analysis of these results reveals that 28 RDM publications were not cited, and only 11 RDM publications had more than 25 citation counts. Moreover, Kenya was found to lead again in terms of citation counts, followed by Tanzania. The detailed analysis of the results is shown in Table 4:

Table 4: Citation Distribution by Country

Number of Citations	Kenya	Tanzania	Uganda	Rwanda	Total	Comm. Freq
0	10	9	7	2	28	28
1	5	0	4	2	11	39
2	5	2	3	1	11	50
3	3	3	3	1	10	60
4	3	6	3	1	13	73
5	2	0	1	0	3	76
6	2	1	0	0	3	79
8	2	1	0	0	3	82
9	1	1	0	0	2	84
10	0	1	0	1	2	86
11	2	0	1	0	3	89
12	3	0	1	0	4	93
13	2	0	0	0	2	95

17	1	0	0	0	1	96
19	3	1	0	0	4	100
21	0	0	1	0	1	101
25	1	0	0	0	1	102
28	1	0	0	0	1	103
31	1	1	0	0	2	105
38	0	1	0	0	1	106
40	1	0	0	0	1	107
41	1	0	0	0	1	108
42	1	0	0	0	1	109
67	1	0	0	0	1	110
101	1	0	0	0	1	111
112	0	1	0	0	1	112
118	0	0	1	0	1	113
Total	**52**	**28**	**25**	**8**	**113**	

Co-occurrence of keywords

Table 5 shows that "Kenya" and "open data" are the most frequently occurring keywords, appearing 28 and 26 times, respectively. Moreover, "Kenya" seemed to have a significantly higher total link strength (110) than other keywords. The higher the link strength, the more it is connected to other keywords in RDM publications. In terms of total link strength, the keyword "Kenya" was followed by "data management" (59), information processing (55) and Uganda (55). Other results are indicated in Table 5:

Table 5: Co-occurrence of Keywords

SN	Keyword	Occurrences	Total link strength
1	Kenya	28	58
2	open data	26	34
3	data management	16	59
4	Tanzania	15	37
5	Uganda	15	55
6	developing countries	14	35
7	information processing	13	57
8	data sharing	11	13
9	information management	11	12
10	open datum	10	17

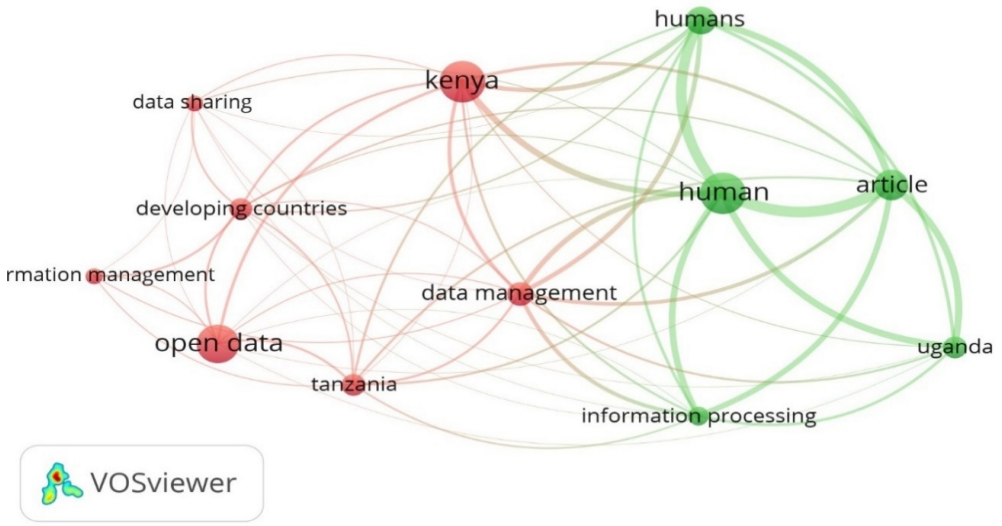

Figure 2: Visualization of Co-occurrence of Keywords

Discussion

The study found that Kenya emerged as the leader in RDM publications in East Africa. This suggests that Kenya had stronger RDM initiatives, more supportive infrastructures and RDM policies than other East African countries (Adika & Kwanya, 2020). Tanzania and Uganda showed a moderate level of RDM publications, contributing about a quarter of them. This implies that they were moderately incubating the RDM practices. Moreover, the results have shown that Rwanda was contributing lower publications as compared to others, something which could be attributed to several factors, including the newness of the RDM concept, related RDM policies, research culture and size of the scientific community (Nishimwe *et al*., 2022). Nishimwe *et al* (2022) and Onyancha *et al* (2015) hold that the extent of publication contribution affects the existing policies, research culture and size of the scientific community). The differences in the number of RDM publications suggest uneven development of RDM initiatives, with Kenya having more support than others. These large differences in the number of publications among East Africans also indicate that, if proper mechanisms are not put in place, there is a greater possibility of having RDM researchers in the same regions with large differences in terms of knowledge, skills and other perspectives, leading to RDM knowledge divide. These findings also imply an unbalanced RDM knowledge economy among the East African countries, with Kenya being the main producer while other countries lag behind.

This supports the view that knowledge producers tend to act, synthesize, control and disseminate knowledge through various means, including publications (Madilo *et al.*, 2022; Marin *et al.*, 2020). These results also express the need to bridge the gap in RDM publications between the East African countries by establishing strong collaboration between the countries. They call for improved facilitating conditions for the RDM practices, including collaborative frameworks.

In connection with this, the region had a very low start in RDM publications, with only seven publications for the first six years (2007 to 2013). Kenya was the only contributor for the first three years. This implies that the concept was still new, and its adoption was at a low pace. As the RDM concept was new, the facilitating conditions for the RDM practices, such as policies, infrastructures, collaborative networks and related ones, were also not in good order, leading to few RDM publications being produced. Since the facilitating conditions promote RDM practices, researchers practice RDM; they also tend to explore and research new RDM areas, which increases the number of publications (Buhomoli & Muneja, 2023a; Kakai *et al.*, 2018). As time passed and some facilitating conditions, such as infrastructures were being improved, the RDM publications also rose, with a maximum peak in 2020, 2022 and 2023. This is in harmony with the previous assertion that as facilitating conditions are improved, the number of publications tends to increase (Buhomoli & Muneja, 2023a; Kakai *et al.*, 2018). The prevalence of research articles as the dominant RDM publication hints that the East African research community is engaging in RDM practices primarily through traditional scholarly outputs. These findings signify that researchers in East Africa are adopting RDM practices in the context of peer-reviewed articles, which are positive perspectives. The findings are in line with Ndhlovu (2021), who also found the prevalence of research articles to be the dominant type of publication in Zimbabwe.

The pattern of the RDM landscape in the region has indicated that few dominant sources attracted some of the publications from the region. However, their overall publications were dispersed across many sources, as most had one publication. This can be evident as there were 113 RDM publications originating from 86 sources (journals). This is equivalent to the ratio of 1.31 publications per journal. This gives different messages to the scientific community. This proposes expertise and interest in RDM in the region, which is broadly distributed among the

journals, reflecting a wider but shallow expertise dispersion. This also points out that the field of RDM in the East Africa region is not concentrated, with the sources (journals) publishing one or two RDM publications over the entire period. This can be interpreted as the RDM knowledge being disseminated in the form of isolated pockets or fragmentation instead of through a uniform source. Due to this, researchers may also face difficulties in keeping up with the RDM developments since the RDM publications are distributed across various journals. This distribution also implies that the field is still emerging; thus, researchers were not concentrating on specific expertise journals. These findings differ from those of Shah *et al* (2024) and Gupta *et al* (2021), who noted the concentration of the RDM publications over the top sources.

In addition to this, there were many RDM publications with low citation counts, signaling little academic impact. This was not a surprise as the concept was still new in East Africa. Likewise, the size of the academic community publishing in these areas was small since it was a growing area. Given the number of publications in RDM, these low citation counts express that much of the RDM publications emanating from the region were not widely referenced by other researchers, either globally or within the region. This portrays several issues, such as insufficient visibility of these publications, limited reach and poor perceived relevance to the wider scholarly community (Adika & Kwanya, 2020; Tang & Hu, 2019). The low citation counts also point to the barriers in East African research associated with dissemination and paywall challenges (David *et al*., 2022; Gupta *et al*., 2021). Further analysis of the findings has demonstrated that Kenya, Tanzania, Uganda and Rwanda had a combined total of 113 RDM publications, but among these, only 24 publications had more than 10 citation counts, pointing out that more has to be done to increase the impact of publications. Despite the rise in the trends of RDM publications over the years, having a low number of highly cited RDM publications implies that most of these works were not influencing their research community. On the other hand, a few highly cited RDM publications demonstrate that East Africa could produce more impactful research projects that resonate within the scholarly community.

Findings have also revealed that some keywords related to RDM were used in RDM publications. These keywords included open data, data management, research data sharing, information processing and open data. These suggest that

the RDM publications from the region focused on critical aspects of RDM. However, the low link strength and low occurrences of data sharing as the keywords indicate that East African publications did not articulate these RDM aspects well. Moreover, some other key elements of RDM, such as data governance, data stewardship, data curation, metadata, data preservation, and data archiving, were not indicated as the most used RDM keywords in East African publications. These are important keywords in RDM practices. Data governance, for instance, is an essential RDM component that ensures compliance and integrity of RDM practices, while metadata is vital for enabling the discoverability of research data. These suggest that although more critical areas of RDM were covered, there were still more fresh areas that needed to be explored. This also signifies that the East African countries were likely to face some challenges if they were to develop their national RDM frameworks, as some of the important concepts were not covered in publications published by their researchers. These results contrast those of Gupta *et al* (2021) and Shah *et al* (2024), who found that most of these critical RDM concepts were covered. The presence of non-RDM keywords expresses that some of these RDM publications addressed the broader research context and did not directly focus on RDM. This implies that governments and research institutions should cooperate to prioritize RDM research for national interest. The findings also concur with those of Gupta *et al* (2021), who noted some non-RDM keywords in their studies.

Conclusion, Recommendations and Areas for Further Studies

The study has provided significant perspectives on the state of the art of RDM publications in East Africa. It has highlighted the maturation of East African RDM publications. The analysis of key areas covered by RDM publications reveals that core concepts such as data management, open data, and information processing were covered, but there were non-RDM related keywords and a lack of critical aspects of RDM such as data governance, curation, stewardship, preservation and others. Moreover, it was noted that most East Africa RDM publications had low citation counts, suggesting low impact, visibility and reach. The presence of uneven sources of RDM publications in the region indicates a fragmented research output across multiple sources, leading to the dilution of their influence.

The study recommends the following: The East African researchers should expand their RDM research beyond basic concepts such as data management data sharing to encompass more complex concepts such as data governance, curation, stewardship, etc. Academic and research institutions in East African countries should strategies on how they could increase the visibility of their publications including RDM publications; and Researchers in East Africa should consider consolidating their research outputs in a highly visible and strategic journals to improve their access, citation and impact. This study was limited to RDM publications indexed in Scopus databases; other indexing databases might yield different results. Future studies should focus on comparative studies across Africa to assess the common challenges, best practices, and status of RDM publications in Africa. Also, the same scope may be covered by using different indexing databases.

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Students' Satisfaction Level with Wi-Fi Services at Dr. Magufuli Library of the Mbeya University of Science and Technology, Tanzania

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Abstract
This study was conducted at Dr. Magufuli Library. It sought to answer whether students using the library were satisfied with the Wi-Fi services and to what extent. Four research objectives were outlined: determining access level, reliability, coverage, and challenges facing students in accessing Wi-Fi services. The study employed a quantitative research approach and a case study design. The researchers distributed 150 structured questionnaires among students. Data collected through the questionnaire were analysed using Microsoft Excel and presented through various graphical representations. The results indicated a high level of satisfaction among students, with 81% agreeing with the Wi-Fi services provided. Most students accessed Wi-Fi through smartphones and personal computers. Additionally, 79% of respondents considered Wi-Fi to be highly reliable, indicating consistent connectivity when needed. The Wi-Fi coverage was reported to extend throughout the library. However, students identified slow internet speed as a significant challenge. Consequently, the researchers recommended increasing internet speed to facilitate quicker access to information, thus saving users' time. Overall, the study highlights the importance of ensuring efficient Wi-Fi services in academic libraries to meet the needs of students effectively.

Keywords: *Wi-Fi, Reliability, Coverage, Students' satisfaction, and Mbeya University of Science and Technology (MUST).*

Introduction

Wireless Fidelity (Wi-Fi) is a technology that uses microwaves in the 2.4 GHz and 5 GHz bands to allow an electronic device to exchange data or connect to the internet wirelessly (Burness *et al.,* 2003). Wi-Fi is defined by the Wi-Fi Alliance as any wireless local area network (WLAN) product that complies with the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards. Users can do anything on the Internet that they can do at home with the Wi-Fi wireless broadband Internet connection. Users can freely browse the internet, check and

send e-mails, connect to their company's network, make free voice-over IP phone calls, play online games, maintain their blogs, and instant message with their friends (Krishnamurthy, 2011).

The strong demand for Wi-Fi connections has grown in part due to the rising sales of laptops and other personal mobility devices (Burness *et al.*, 2003). In 2008, the number of people using wireless computers to access the internet reached an all-time high (Centre for the Digital Future, 2008). There is ongoing concern that those who are slow to accept and use the Internet will be left behind when it comes to high-speed connectivity and Wi-Fi technologies. As a result, people will not obtain satisfactory services (Fox and Livingston, 2007).

According to Ming (2010), learners can benefit from the use of wireless technology by enhancing their interest in education and allowing them to overcome physical barriers to learning. Fried (2006) investigated the use of wireless internet to facilitate learning in the university environment and how students are satisfied with the wireless connection. The study discovered that having a choice of location, a better learning environment, schedule flexibility, easy participation in group projects, and greater contact with instructors and other learners can all help to promote student-centred learning. To fully utilize wireless technology, new teaching methodologies and models must be established (Lu, 2003).

According to Ijiekhuamhen *et al* (2015), library user satisfaction refers to the extent to which library users' information needs have been addressed and the degree to which their satisfaction encourages continued use of library resources and services. Every modern library's primary aim is to meet the information needs of its patrons. Library and information professionals strive to meet the information needs of every library user to the greatest extent possible. The application of information and communication technologies (ICTs) in the normal operations of 21st Century libraries is the consequence of this search to satisfy library customers' information needs. Hence, assessing students' satisfaction level with library Wi-Fi services is an important aspect to discuss.

Statement of the problem

Libraries are known for offering information resources and services to assist teaching, learning, research and community services in any institution. As a result, the quality of information resources and services provided should be consistent

to suit the needs of users (Briz-Ponce *et al.,* 2017). Librarians can establish whether the library's information resources and services are satisfactory by talking to patrons. It will resemble a warehouse if consumers do not use the library's information resources and services. In this opinion, computers and internet technologies are expected to have a greater impact (Weimann, 2006). The use of Wi-Fi by students has expanded rapidly as a result of the dissemination and expansion of cheaper and more user-friendly computer technologies (smartphones and portable PCs). Students can use the Internet to improve their academic performance, get experience, obtain crucial academic information, and communicate with other academics (Tella, 2007). Despite the potential benefits of the Internet for learning, teaching and research, higher institutions such as universities have limited access to reliable wireless Internet connections (Ureigho *et al.*, 2006). This is a problem because it affects students' learning and performance as they fail to obtain information when seeking the service. As a result, determining the level of satisfaction with library information resources and services for future advancements will require analyzing users' satisfaction with library information resources and services. Therefore, the aim of this study was to explore the level of students' satisfaction with the Wi-Fi services at Dr. Magufuli Library.

General objective

The main objective of the study was to assess the students' satisfaction level with Wi-Fi services at Dr. Magufuli Library.

1.3.1 Specific objectives

i. To determine the level of access to Wi-Fi Internet at Dr. Magufuli Library.
ii. To assess the reliability of the Wi-Fi Internet at Dr. Magufuli Library.
iii. To identify the coverage of the Wi-Fi Internet at Dr. Magufuli Library.
iv. To determine challenges facing students in accessing Wi-Fi Internet at Dr. Magufuli Library.

Significant of the study

The findings of this study are important to Tanzanian academic libraries, especially in the areas of policy and strategy formulation, as they are going to act as a yardstick in library advocacy and promotion. Similarly, it is foreseen that they are going to create awareness among the academic library boards and management as regards the students' satisfaction level with library Wi-Fi services provided. It will provide benefits to students, libraries and universities up to the

national level and act as a consultation for further research to be conducted based on this area of discussion. Understanding students' satisfaction level with library Wi-Fi services helps to retain customers because retaining satisfied customers is cheaper than acquiring new ones. It will help the library keep its brand ahead of other competitors. It will also promote customer retention and loyalty. Various policies and guidelines will be enacted to facilitate better service provision at all levels of development. This will then enable the development of the library from the community to the national level and will be useful for future trends of development.

Scope of the study

The research was carried out only at one public higher learning institution in Tanzania. The study was conducted in Mbeya City, specifically at the Mbeya University of Science and Technology Library. It concentrated on assessing students' satisfaction level with Wi-Fi services at Dr. Magufuli Library. Additionally, the research focused on the MUST Main Campus only; other campuses were not part of this research.

Literature review

Level of access to Wi-Fi Internet in academic libraries

Academic libraries, like other libraries, began offering Internet access in the early 1990s. Odero (2007) investigated Internet access in Kenyan universities since 1990s and discovered that some university computers connected to the Internet were housed in specific rooms under the supervision of library management and that staff needed permission from library management before using the Internet. Others taxed their employees for Internet access and ensured that it was only available during lunch breaks or after work hours. Odero also found that none of the libraries had a formal training program for its employees, and if they did, it was primarily for senior staff. Individuals were in-charge of their Internet training.

Wi-Fi technology has been implemented by academic libraries in South Africa. The University of Free State began a project to establish Wi-Fi infrastructure on all three of its campuses in 2012 and 2013. The goal of this project was to enable wireless connections to students and staff across the three campuses. The institution was able to install 150 access points and six mobility controllers throughout the campuses and around 30000 people connected to the network (Aruba Networks, 2014).

According to Jaeger *et al* (2007), in the United States, between 2004 and 2006, 98.9% of academic libraries were connected to the Wi-Fi, and 98.4% of connected academic libraries offered wireless access. There were, however, disparities in the level of access offered, the types of access available, and the sufficiency of the access available to meet patrons' demand. Patrons, communities and increasingly government agencies relied on the notion that everyone who required it would have access to the Internet. Studies have indicated that wireless internet mobile learning among college/university students has resulted in a profound and diverse pool of information based on the use of Wi-Fi internet. Ahmed and Bukar (2016) discovered, for example, that most Adamawa State University students in Nigeria who use the wireless Internet for educational and leisure purposes rely on their mobile devices.

Reliability of Wi-Fi internet in academic libraries

The characteristics that contribute to the word 'reliability' include being dependable, consistent, and stable. It is a quality indicator that a service, particularly any computer-related component like software, hardware or a network, continuously functions according to its specifications (Elizalde, 2018). The three connected properties that must be considered while creating, purchasing or using a computer product or component are critical. Most university students consider internet connection reliability to be one of the beneficial aspects of Wi-Fi internet services. Customers would believe that the service has a high possibility of effectively operating their internet connection every time they require it if the reliability connection score is strong (Elizalde, 2018).

For e-government wireless connection (Wi-Fi) to be a success with the citizens and various academic institutions, they should be able to connect to state infrastructure dependably, with the Wi-Fi connection being reliable, available and secure. The infrastructure connecting government's offices and departments is under its control, but not the commercial connection, and its citizens, in particular, rely on external third parties. Furthermore, some of the dependability will be dependent on the citizen's and institution's capacity to set up a wireless connection, which suggests a level of knowledge that a citizen is unlikely to possess (Furnell, 2005). Furthermore, most upcoming radio technologies for wireless personal area networks, such as the Bluetooth protocol and personal Wi-Fi, are designed to work in the 2.4 Gigahertz range as well. Because Bluetooth and IEEE 802.11 devices use the same frequency band and are likely to be near

each other on a laptop or a desktop, interferences can cause severe performance loss, affecting the Wi-Fi internet's reliability (Furnell, 2005).

Coverage of Wi-Fi Internet in academic libraries

When students at the National Institution of Malaysia (Universiti Kebangsaan Malaysia) are in the vicinity of the university, they can use Wi-Fi services to get information they need. When they are on campus, they will be able to access a range of online technology tools (Yerulshalmy and Ben-Zaken, 2004). At Kuvempu University, a study on wireless Internet usage was done with the participation of students and faculty. According to the survey faculty and students utilize the Internet for learning and teaching. This is because Internet has covered the entire neighbourhood; the library was designated as the preferred location for using the wireless internet. Most students and faculty members are content with present Internet sources and services (Biradar *et al.,* 2006).

Challenges facing students in accessing Wi-Fi services in academic libraries

Libraries in impoverished nations confront several challenges when it comes to implementing modern technologies such as Wi-Fi. Many researchers have discussed the Internet's slow pace, limited time to use the web, information explosion and loss, copyright, access constraints, source legitimacy and accuracy, expensive subscription costs, bad hardware, inexperienced personnel, users' inability to access the Internet, and lack of awareness (Darries, 2003; Mugwisi and Ocholla, 2002; Saeed *et al*., 2000; Younis, 2002). According to Fasae and Adegbilero-Iwari (2015), inadequate Internet connectivity is one of the main challenges facing scientific students in Nigerian private colleges.

Theoretical and conceptual framework

The Functional Attitude Theory (FAT)

As per Functional Attitude Theory (FAT), beliefs and attitudes have impact on a variety of psychological functions. They have the potential to be beneficial and assist people in interacting with the world (Smith *et al*.,1956). Katz (1960) separately and independently constructed typologies of human attitudes about the functions to which they believed the attitudes served in the late 1950s when psychoanalysis and behaviourism ruled supreme as the emphasis of psychological studies. The purpose of an attitude is more essential than whether it is correct. This will then lead an individual to attain several traits of satisfaction or

dissatisfaction based on the attitude he or she developed towards a given phenomenon.

Conceptual framework

Based on the preceding reviewed articles, this study has distinctly identified significant factors or variables that need to be examined. Further, the researchers came up with a model appropriate to higher education institutions' delivery of good-quality WIFI internet services.

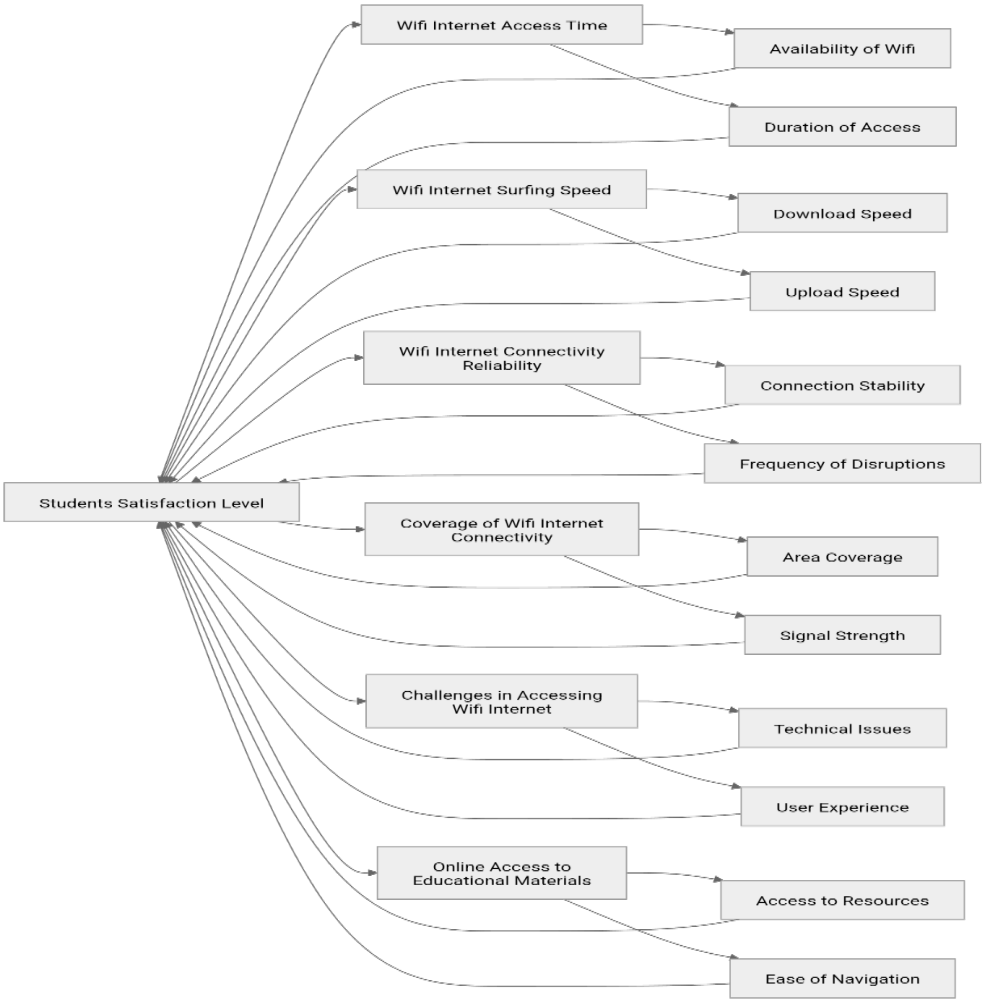

Figure 1: Conceptual Framework of the Study
Source: Researcher's Design (2024)

Materials and methods

A case study design was adopted in this study employing quantitative approach. The research was conducted at the Dr. Magufuli Library, Mbeya University of Science and Technology. It is one of the university libraries that has had a significant impact on the use of electronic resources and the provision of online services. The study employed a stratified and simple random sampling method in selecting the number of respondents to be included in a study at the first stage. Respondents, particularly students were divided into departments. Then, according to the sample size, a simple random selection was used to select students from each department. The sample size was determined using Slovin's Formula. It is used to determine the sample size (n) based on the population size (N) and the margin of error (e). Thus, n = N / 1+N(e)2 was the formula which was used. If a population sample is obtained, a formula must be employed to account for confidence levels and margins of error (Creswell and Creswell, 2017). The size of the population (N) was 240 students, and the margin error (e) was 0.05. Hence, the calculated size of the sample was 150. This is expressed as n=240/1+240(0.05)2. Questionnaires and documentary reviews were used to collect data. Ethical issues, reliability, and validity of data were also considered. Quantitative data acquired via questionnaires was processed and analyzed, displayed in tables, figures and pie charts using Microsoft Excel.

Results

Respondents' educational levels

Students from different colleges were given a total of 150 questionnaires. A total of 114 completed questionnaires were received, with a response rate of 76%. Collected data through questionnaires was analysed for clear understanding, presentation, and analysis. Respondents' educational levels are presented in Figure 4.1 below, which shows that 10 (8.77%) respondents are certificate students, 40 (35.09%) are diploma students, 57 (50%) are bachelor's degree students, and 7 (6.14%) are postgraduate students. The findings revealed that bachelor's degree and diploma students participated to a large extent, followed by certificate and postgraduate students, respectively. Bachelor's degree and diploma students participated a lot because they frequently use the wireless internet to search for reading materials for various courses they attend. Some search information related to subjects, jobs, electronic resources, and entertainment purposes via social media platforms like Instagram and Facebook.

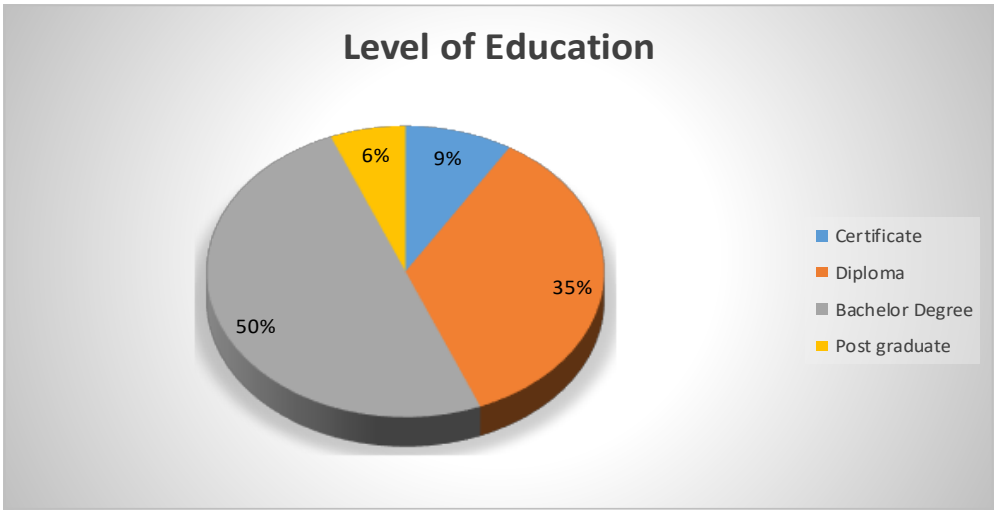

Figure 4.1: Respondents' level of education
Source: Data from the field (2024)

Level of access to the Wi-Fi internet at Dr. Magufuli Library

The level of access to the Wi-Fi Internet is considered well when shown in various aspects such as tools for accessing the Wi-Fi Internet, login credentials for the Wi-Fi Internet, and the overall frequency of use of the Wi-Fi Internet.

Tools for accessing the MUST Library Wi-Fi internet

It was found that accessibility of Wi-Fi at Dr. Magufuli Library through smartphones was high, contributing to 35.97% of the total response; personal computers followed with a 33.33% rate. The library computers contributed 21.05%, and other gadgets had 9.65% of the total response. This revealed that smartphones, personal computers and library computers are mostly used tools for accessing the Wi-Fi internet at Dr. Magufuli Library. Most students possess smartphones; hence they are using them as tools to access the library's Wi-Fi Internet. Those who do not use smartphones have access to their personal computers. The rest of the group uses library computers and some access via other gadgets such as palmtops. Table 4.1 depicts tools preferred in accessing Wi-Fi:

Table 4.1: Tools for Accessing Wi-Fi internet at Dr. Magufuli Library

Tool of Access	Frequency	Percentage (%)
Personal Computer	38	33.33
Smartphones	41	35.97
Library Computers	24	21.05
Other gadgets	11	9.65
Total	**114**	**100**

Source: Field Data (2024)

Login credentials for Wi-Fi internet at Dr. Magufuli Library

The findings of the study revealed that 114 respondents, which constitute 100% of the total responses, log in to the Wi-Fi internet at Dr. Magufuli Library using passwords. A password was available for users to log in when using the Wi-Fi internet. The response rate for accessing without a password was none (0%), meaning that the only way to access the Internet is through password-protected access. The passwords are set to prevent other users who are not university students from accessing Wi-Fi Internet. The passwords are found in the library and written on top of help desks in each department.

Table 4.2: Login Credentials for the Wi-Fi internet at Dr. Magufuli Library

Login Credential	Frequency	Percentage (%)
Password-protected access	114	100
Free access	0	0
Total	**114**	**100**

Source: Field Data (2024)

Frequency of use of the Wi-Fi Internet at Dr. Magufuli Library

Most respondents, 84 (73.7%), used Wi-Fi services "daily," while roughly 21 (18.4%) used "as and when needed," 6 (5.3%) respondents used "twice a week," and just 3 (2.6%) respondents used Wi-Fi services "once a week". Students use the Wi-Fi Internet daily because of their need to accomplish various activities. Hence, their daily needs are high compared to those who only use the Wi-Fi Internet as and when required.

Table 4.3: Frequency of Use of Wi-Fi Internet at Dr. Magufuli Library

Wi-Fi Usage Frequency	Frequency	Percentage (%)
Everyday	84	73. 69
Once per week	6	5.31
Twice per week	3	2.59
When needed	21	18.41
Total	**114**	**100**

Source: Field Data (2024)

Reliability of the Wi-Fi Internet at Dr. Magufuli Library

Most university students consider reliability of the Internet connection to be one of the desirable aspects of Wi-Fi Internet services. This is because the dependability connection yielded a positive outcome; users believed that the service had a high possibility of properly operating their internet connection every time they needed it. The study found that 90 respondents (79%) considered Wi-Fi Internet highly dependable, 14 respondents (12%) considered Wi-Fi Internet moderately reliable, and 10 respondents (9%) considered Wi-Fi Internet not reliable. This has shown that the reliability of the Wi-Fi internet at Dr. Magufuli Library is highly reliable based on quantitative measures because 90 respondents (79%) considered it to be highly reliable.

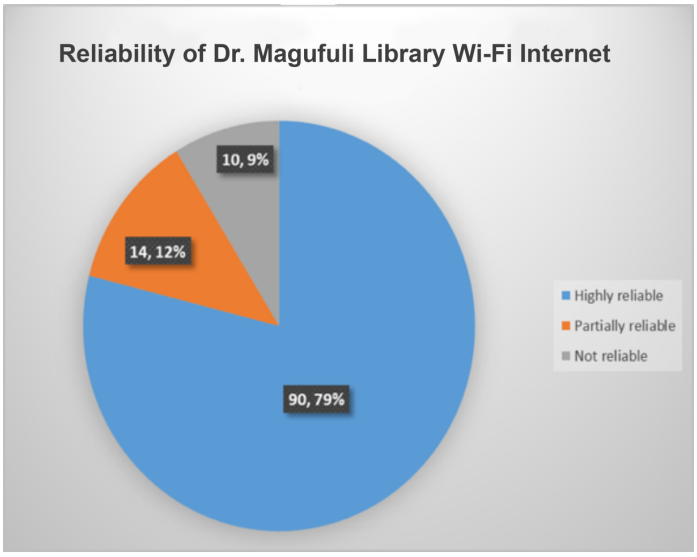

Figure 4.2: Reliability of the Wi-Fi Internet at Dr. Magufuli Library
Source: Field Data (2024)

Speed of Wi-Fi Internet connectivity

The upload speed is measured by the number of bytes per second that travel from a user's device to an internet host, and the download speed is measured by the number of bytes that travel back from an internet host to the user's device (Elizalde, 2018). The findings have shown that the speed of Wi-Fi Internet connectivity at Dr. Magufuli Library was 10 Mbps (megabits per second). Research findings revealed that 60 respondents (52.63%) considered the speed of the Wi-Fi Internet connectivity to be moderate; the other 40 respondents (35.09%) considered the speed was high, and 14 respondents (12.28%) considered the speed of the Wi-Fi Internet connectivity low. Results of the study concluded that the speed was moderate. The speed was moderate because a large number of users accessed the Internet, making it overloaded. Also, frequent electricity disconnection at the Dr. Magufuli Library led to the moderate speed of the Wi-Fi Internet connectivity.

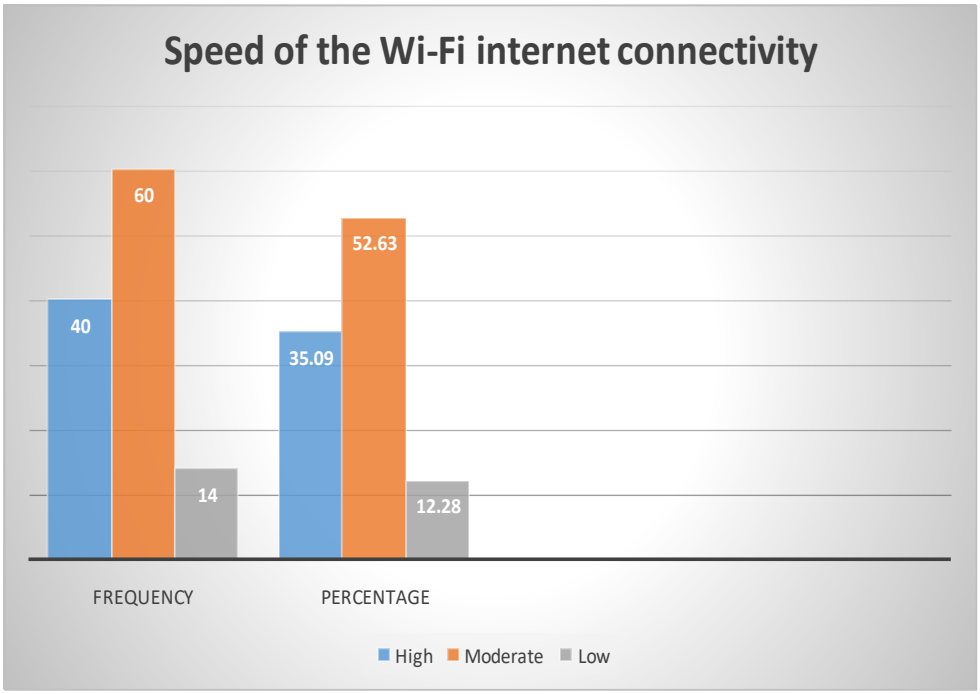

Figure 4.3: Speed of the Wi-Fi Internet Connectivity
Source: Field Data (2024)

Coverage of the Wi-Fi Internet at Dr. Magufuli Library

The coverage of the Wi-Fi Internet included the entire library building with its associated departments. Research findings of the conducted study revealed that the Wi-Fi Internet covers the entire library, as 114 respondents (100%) answered "yes" when asked about whether the Wi-Fi Internet covers the entire library building with its associated departments.

Challenges facing students in accessing Wi-Fi internet

Most respondents, specifically 55 (48.25%) said that a key issue they face while using a Wi-Fi connection is 'low internet access speed'. Moreover, 38 (33.33%) respondents agreed that 'frequent disconnection' is a barrier to using Wi-Fi, while 15 (13.16%) users stated that 'limited connectivity' is a barrier to using Wi-Fi connections. In addition to that, 6 (5.26%) respondents stated that 'less renewal period' is a barrier to using Wi-Fi. The top obstacles which students face in using Wi-Fi Internet are therefore slower internet speeds and frequent disconnection, as summarized in Figure 4.4:

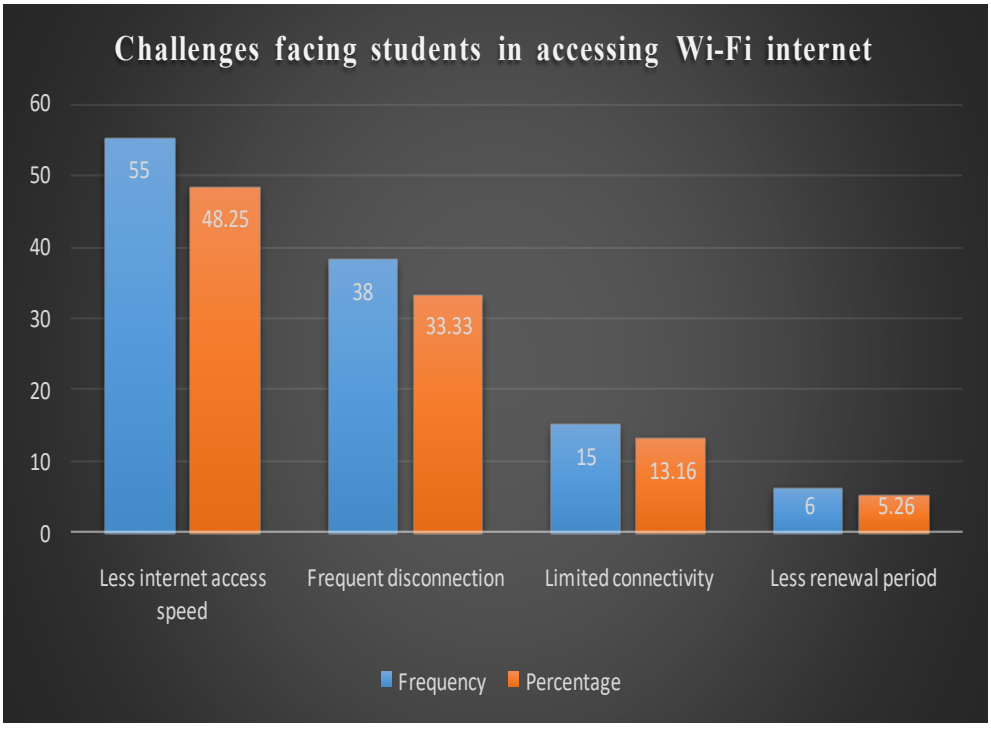

Figure 4.4: Challenges Facing Students in Accessing Wi-Fi Internet

Source: Field Data (2024)

Satisfaction level of Wi-Fi Internet at Dr. Magufuli Library

Satisfaction is defined as the statement of fulfilment of an expected outcome impacted by preceding quality expectations. It is simply the satisfaction of one's desires, expectations or needs, or the joy of doing so (Locke, 1976). It is observed in Table 4.4 that 25 respondents (21.93%) are fully satisfied with the Internet, whereas 46 respondents (40.35%) are satisfied. Also, the research findings show that 7 respondents (6.14%) are partially satisfied, 20 respondents (17.54%) are satisfied to some extent, and 16 respondents (14.04%) are not satisfied with the Wi-Fi Internet at Dr. Magufuli Library. This concludes that overall respondents are satisfied because most of their needs and expectations relating to Wi-Fi internet have been met.

Table 4.4: Satisfaction level of Wi-Fi Internet at Dr. Magufuli Library

Level of Satisfaction	Frequency	Percentage (%)
Fully satisfied	25	21.93
Satisfied	46	40.35
Partially satisfied	7	6.14
Intently satisfied	20	17.54
Unsatisfied	16	14.04
Total	**114**	**100**

Source: Field Data (2024)

Opinion of Users on Satisfaction of Wi-Fi Services at Dr. Magufuli Library

The majority 93 (81.58%) of the respondents said were satisfied with the Wi-Fi services offered by the Mbeya University of Science and Technology Library, as indicated in Table 4.5. The remaining 21 (18.42%) respondents, on the other hand, reported that they were dissatisfied with the Wi-Fi service. As a result of the research, it is obvious that most Dr. Magufuli Library users are satisfied with the Wi-Fi services provided.

Table 4.5: Opinion of Users on Satisfaction of the Wi-Fi services at Dr. Magufuli Library

Users' opinion	Frequency	Percentage (%)
Yes	93	81.58
No	21	18.42
Total	**114**	**100**

Source: Field Data (2024)

This concludes that overall respondents are satisfied because most of their needs and expectations relating to Wi-Fi Internet have been met.

Discussion

This paper aimed to determine how satisfied students were with the library's Wi-Fi services at the Dr. Magufuli Library, Mbeya University of Science and Technology. The study was guided by four research objectives: to determine the level of access to the Wi-Fi Internet, to determine the reliability of the Wi-Fi Internet, to determine coverage of the Wi-Fi Internet, and to identify challenges students face when using library's Wi-Fi Internet. The study's findings revealed that students are content with the Wi-Fi Internet or services available at the MUST library, as most respondents (81%) agreed on satisfaction with the Wi-Fi Internet, which was the study's main goal. In terms of the Wi-Fi Internet access given, the findings revealed that students utilize smartphones and personal computers to access the Wi-Fi Internet. According to the findings, 79% of respondents considered Wi-Fi Internet extremely reliable. This means that the connection is stable and reliable every time they use the service. The Wi-Fi Internet was available throughout the library. When using Wi-Fi Internet, the respondents identified a slow internet connection as a main issue. Furthermore, to broaden the scope of this paper, various kinds of research are recommended, including but not limited to assessing students' attitudes towards library Wi-Fi services in any academic institution, a comparative study on wireless internet services and customer satisfaction in various fields of study, and the degree to which users are satisfied with ICT-based resources and services.

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Role of Online Health Information Resources in Shaping Self-confidence of Nursing and Midwifery Students in the Digital Era at Aga Khan University, Tanzania

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Abstract

Digital technologies have transformed the way people learn in the current age. Innovative multimedia online nursing and midwifery information resources have improved nursing education and brought about adaptive, interactive, and collaborative learning. This study aims to find out whether the online nursing information resources provided at Aga Khan University Tanzania are shaping the self-confidence of nurses and midwives in the digital era, to understand gaps and areas for improvement. This study used both quantitative and qualitative research approach were used. The researchers collecting data using online Google Forms, which were analysed thematically through Atlas ti. The results revealed that persistent access and use of online information resources largely shaped the self-confidence of nursing students during examinations and at the point of patient health care. The participants who navigate the online information resources often gained more knowledge and skills to apply at times of need, either during examinations or nursing and midwifery practices. The more knowledge and skills gained through the online resources and used, the more the student's gained self-confidence. The participants reported that, they felt very confident because of their critical thinking skills, the informed decisions they made, and the problem-solving that made them confident. The most used resources were Health Internetwork Access to Research Initiative (HINARI), EBSCO host, Up to Date, Clinical Key Nursing and Clinical Key for physicians. Difficulties experienced by the students were unreliable and expensive Internet connections while on off campus, the long process of logging in, and subscription restrictions to some content were mentioned also as challenges.

Keywords: *Library automation, Clinical care, Nursing education, Self-efficacy, Digital content, Aga Khan University, Tanzania.*

Introduction

The revolution from learning with a blackboard to learning with digital technologies has radically transformed education. Recent evaluations have released findings on accessing education, delivering information and varying learning communities (Lewis *et al.*, 2014). In the 21st Century, with the rapid

growth of technology, nursing students are constantly challenged with newly emerging healthcare knowledge that they are expected to know (Wiecha *et al.*, 2010). The quantity of online resources is increasing ascendingly. In supplement to print resources, lectures and seminars, nursing students are now progressively accessing and using online health resources for learning clinical skills and evidence-based (Barteit *et al.*, 2019). Digital learning has developed a widespread method for providing health education training. This advanced approach to teaching extends exceptional learning prospects for nursing learners (Lewis *et al.*, 2014).

The integration of online information resources into nursing education shifts toward learning theory. Students will no longer be waiting for content distributors; rather, they become involved as facilitators, researchers, up-to-date learning and competency evaluators (Barteit *et al.*, 2019). With the intensity of beyond, there is extensive use of smartphones and iPads in accessing information regarding medical, treatment and clinical situations (Jang and Kim, 2014).

According to Lewis *et al* (2014) online health information resources are a practical solution for nursing students facing different challenges. These include enhancing self-learning and self-confidence, flexible learning opportunities, collaborative learning and widening professional development among nursing students. Ruiz *et al* (2006) Therefore, innovations driven by online health information resources lead to a revolution in health education, bringing adaptive and collaborative learning.

Nurses are found to be a primary strength of the health system. Nursing is a requisite occupation as it offers universal care to patients. Nurses are required to be well-equipped for substantial clinical practice. The study conducted by Unver *et al* (2017) found that most graduate nurses are straining to deliver safe care to patients because they have weak critical thinking, minimal self-confidence and lack of ability in performing and providing value care. Consequently, nursing learners must cultivate and develop confidence while they are still studying. They can easily learn from online experiments, online case studies and evidence-based collections to be able to gain confidence not only at the point of clinical care but also in academic pursuits. Furthermore, for health practitioners to make evidence-based clinical procedures and decisions, they require regular access to reliable clinical information resources.

General objective

The study aimed at exploring the contribution of online nursing information resources provided at Aga Khan University, Tanzania in shaping the self-confidence of nurses and midwives in the digital era and identifying gaps and areas for improvement.

Research questions

The following questions guided the study:

Q1. How frequently do nursing and midwifery students use online health information resources?

Q2. What databases are frequently used?

Q3. What are the perceptions of nursing and midwifery students on online health information in relation to their self-confidence during exams and at the time of health care practices?

Q4. What reasons are nursing and midwifery students giving in relation to self-confidence?

Q5. What difficulties are the students encountering when accessing online health information resources?

Literature review

Global perspectives on online nursing information resources

The study conducted in Korea shows that there has been an emphasis on refining the learning of clinical skills in health, and online health learning has been implemented in health education (Jang and Kim, 2014). The studies indicated the benefits of online resources to nursing learners as helping to review clinical skills, which occasionally are difficult to understand by just taking lectures, refreshing, exploring and learning new skills, and memorizing before practicing medical procedures. The findings of this study show that e-learning can be of many advantages in meeting the needs of nursing students to complement traditional learning of health education (Jang and Kim, 2014).

A study conducted in Malaysia reports that a basic level of Evidence-Based Medicine (EBM) is necessary for all health graduates. For health practitioners to make evidence-based clinical procedures and decisions, they require regular access to reliable clinical information resources (Lai and Nalliah, 2010). Consequently, frequent access to and usage of online health resources heightened students' confidence in navigating into several medical databases. Nursing resources are

also frequently accessible in different online medical databases such as Cochrane Library, PubMed/Medline, Blackwell Synergy Collection and OVID (Lai and Nalliah, 2010). The study carried out in the USA regularly shows that health workers and nursing students are using mobile medical software applications (apps) at the point of care for clinical decision-making and virtual medical resources are as reliable as textbooks (Quant *et al*., 2016). Nursing students believe in the consistency and efficiency of online resources and use them out of fear.

Online nursing health information resources in sub-Saharan countries

Many universities and training colleges in Africa usually focus on a face-to-face method of learning in health colleges, including nursing (Nyemike Simeon *et al.,* 2022). Online learning for health education in underdeveloped countries is low, and the potential of online learning to support the innovation of health training is nevertheless unknown (Barteit *et al*., 2019). However, sub-Saharan countries have proceeded considerably in the early few years in the advancement of technology, connectivity and internet access; society is now accessing and using online content more than ever, and this development provides productivity stimulation to e-learning in health education, nursing included.

According to Owino *et al* (2016) Kenya's studies about information-seeking practices among health students reveal that medical students in sub-Saharan countries believe in print textbooks as a significant informant of general health information. However, they prefer online information which is absolutely linked to initial biomedical literature such as PUBMED and HINARI.

The study carried out in Uganda found that e-learning is described as a valuable opportunity for the continuation of nursing education. The awareness about online learning among health students is rising; however, the main challenge of digital learning in most of developing countries include lack of infrastructures. The study of Olum *et al* (2020) noticed that the cost of the internet is very high with poor connectivity, and lack of technical skills among nursing students in the usage of online resource platforms.

Impacts of using online health information resources on nursing students

Health students obviously switched from printed information sources and references to digital information sources as their favoured source of information for responding to their enquiries. It is reported that confidence increases in search

of online resource activities to medical students as a result of evidence-based medicine training (Lai and Nalliah, 2010). Also, different medical applications improve clinical skills and have an optimistic effect on medical student education (Quant *et al.,* 2016). As online nursing resources become more and more available and accessible, it is critical that their use as learning aid and clinical settings are measured, their impact on the learner's ability to recall, confidence and on patient handling and engagement (Ryan *et al.,* 2020). Nursing students also trust in the reliability and utility of medical apps (Quant *et al*., 2016).

Online health information resources enhance health trainee education; they help nursing students to obtain more information to master skills better and solve problems quickly. New Online technologies for learning and teaching normally enhance competency, and once the nursing student is competent to undergo certain medical procedures, the probability of medical procedure errors is very minimal. Furthermore, the advancement of online resources provides a reliable setting for medical students to prepare and practice before performing a medical procedure. It is the beginning spot of an improved healthcare service delivered by future doctors (Prababika *et al*., 2021, Rizvi *et al*., 2021, Jang and Kim, 2014).

Lewis *et al* (2014) express that online resources have improved educational capability and made it simpler to share educational resources. They increased access to education, creating a more flexible learning environment. They also shaped and created extreme changes in health education. The practice of online health resources has further assisted health students to be able to assess capabilities and milestones, and provide to students the tools to continue to access health knowledge and to deliver superior care (Guze, 2015).

Online health information and self-confidence

According to Perry (2011) self-confidence is the acknowledgement that people have their identifiable abilities, emotions and beliefs to achieve goals, hopes and desires. Likewise, Preston (2011) elaborated that self-confidence is the faith of being successful and the capability to consider themselves and their abilities in distinct circumstances to embark on a given duty. Self-confidence is consequently about focusing on activities as well as the capability to accomplish these activities effectively (Moneva and Tribunalo, 2020).

Self-confidence is also formed by a person's character, understandings, opportunities, community, cultural and social circumstances; an individual's

previous practices and standard can also enlighten confidence (Gottlieb *et al.*, 2022). Self-efficacy Theory is the one which might be associated with self-confidence, and its model is in the reflection individuals make regarding creating, organizing and performing a certain activity regardless of behaviour and level of performance. Therefore, self-confidence is connected to a person's level of assurance in positively accomplishment of an activity and succeeding in its effect (Perry, 2011).

Self-confidence is a complex and multi-faceted trait that influences how individuals perceive and approach their abilities, challenges and interactions with others. Several theories and frameworks have been proposed to understand and explain self-confidence such as Bandura's Self-Efficacy Theory. Bandura's theory emphasizes the role of self-efficacy in self-confidence. Self-efficacy is the belief in one's ability to succeed in specific situations through mastery of experience, vicarious experience, social persuasion and physiological or emotional states (Lippke, 2020; Ouyang *et al.*, 2023). Trait vs. State Self-Confidence: People who can endure are stable and generally confident in various conditions, while a person's state of self-confidence changes with specific tasks (Adalikwu, 2012; Perkins, 2018). Self-Discrepancy Theory: This was proposed by E. T. Higgins. This theory suggests that the discrepancies between different self-understandings influence self-confidence such as how currently one sees self, how one would like to be and how one believes one should be (Bak, 2014; Fordham *et al.*, 2021). Fixed Mindset vs. Growth Mindset is Carol Dweck's theory which posits that individuals who are self-confident with a fixed mindset believe their abilities are static and unchangeable. This kind of mindset is affected by challenges. Conversely, those with a growth mindset believe their abilities can develop through efforts and learning, which generally fosters higher self-confidence (Hertel and Karlen, 2021; Storey and Geier, 2024). The growth mindset seeks knowledge and skills, but it can also learn and gain competencies for self-confidence. Cognitive-Behavioural Theory focuses on how thoughts and beliefs affect emotions and behaviours. Negative self-talk and irrational beliefs can undermine self-confidence. Cognitive-behavioural strategies aim to challenge and change these thoughts to improve self-confidence (Hofmann *et al.,* 2012; Storey and Geier, 2024).

Understanding self-confidence involves recognizing that it is not just about having a positive view of oneself but also about developing resilience, adapting to challenges, and cultivating a mindset that supports personal growth and self-

improvement. Researchers believe that to understand the way online health information shapes self-confidence of nursing and midwifery the implicit theory of fixed mindsets and growth mindsets can provide a better understanding. The fixed mindset does not seek learning and information. It assumes satisfaction. The growth attitude where people trust their competencies can develop through determination and learning, which fosters higher self-confidence (Richardson *et al.*, 2021). Through self-efforts of seeking information and learning through online health resources, students gain an understanding of concepts and issues that they come across during examinations and health care.

Self-confidence influences all attributes of an individual's lifetime. It is crucial in health and medical fields as well, including nursing students' life (Muniandy *et al.*, 2015). A nursing and midwifery professional with positive self-confidence can convey professional attributes that impact the patient's health recovery process (Kukulu *et al.*, 2013).

Self- confidence changes in different incidents including establishing exactly how nursing professional performance is enhanced when it thoroughly relates to certainty (Omer, 2016). Self- confidence moderates the accomplishments and intuitions of nursing students, structures students on universal intelligence of competency; also, forms nursing students' self-motivation, emotional responses, reasoning and performances (Jang and Kim, 2014).

However, among the rigorous issues nursing students face after completing their studies is a lack of self-confidence in clinical practices, especially during emergencies. This might be due to the lack of clinical practice and experience during their undergraduate studies. Therefore, nursing simulation is merely the bridge from novice nursing students to confident and professional nurses (Muniandy *et al.*, 2015). Therefore, self-confidence is required in order to deliver reliable support to the patients which is unrestricted from oversights (Unver *et al.*, 2017).

Online health resources and nursing students' self-confidence

Generally, self-confidence influences success in every part of life, including work, family, relationships, study, daily performance and other activities. Self-confidence is the greatest asset; people with full information normally are confident in making decisions (Preston, 2011). Online resources are extensive sources of information for health professionals. According to Alabdulwahhab *et*

al (2021) students are much more fulfilled with online learning if it is totally linked to their courses and learning. They perceive online resources as an appropriate way of learning, as they contain information that is recognizable to the practices of their nursing courses.

Jang and Kim (2014) stated that the major motivation for nursing students to choose online resources as an educational approach is they are easy to access, reliable and carry quality information; it is also due to their convenience and alignment with the curriculum. The study carried by Tabriz *et al* (2024) found that self-confidence among students improves their skills and knowledge, whereby self-confidence of nursing students was extensively enhanced through utilizing virtue resources. Therefore, online learning resources to nursing students have been concluded as an effective system of learning which automatically reduces facilitators, giving learners opportunities to be vigorous, exercise and give out an analytical learning from their mistake on a specific experience before the actual one (Laschinger *et al*., 2008).

Challenges that constraint access to online health information resources

Nursing students as well as instructors lack consistent data and detailed information concerning online health resources to support their learning process and how to access online resources related to their crucial learning (Judd and Elliott, 2017). Also, the limitations of nursing students accessing and using only a single source of information of online resources such as journals as the only source of information, while there are several e-resources and clinical evidence which can be accessed via different Database (Lai and Nalliah, 2010). Negative attitudes amongst nursing educators not cooperative with modern technologies and tools could contribute to the process of development and implementation of online learning(Rizvi *et al*., 2021). Ajayi (2004) although nursing students have an approach to a wide variety of online resources, including highly worthwhile clinical and biomedical resources, many students tend to rely on a limited number of online resources and ignore exploring a wide range of current online resources. Moreover, Low knowledge among learners about e-resources, lack of technical skills in accessing and using online learning platforms, not having a personal computer or laptop with poor and low access to the internet, and internet cost facilities also contributed to low access to online medical resources among nursing students (Rafi et al. 2020, Oladipo *et al*., 2020, Olum *et al*., 2020).

Salari and Sepahi (2021) also note that the absence of practical skills is the main obstacle hindering nursing students from accessing and using online education resources. In addition, most health students are unaware of different e-learning searching skills and strategies. There is also a lack of strong units in colleges and universities to support nursing students in digital and e-learning.

Methodology

This study used a semi-structured open-ended qualitative questionnaire using online Google Forms to gather data. The researchers employed purposive sampling to obtain the participants suitable for the study. Creswell and Clark (2018) explain that purposive sampling helps researchers use participants who are more significant to the study. Because the students were clustered according to programs, the researchers applied quota sampling to ensure every cluster was represented in the survey. Quota sampling is a non-probability sampling technique that uses available participants to present a population quota (Iliyasu & Etican, 2021; Pace, 2021). Narratively, the participants were encouraged to share their personal experiences about the use of online health information and self-confidence. Thematic analysis was used through Atlas ti version 24. Atlas ti is a qualitative data analysis software used to generate themes from the data after coding and grouping codes in related terms (Gupta, 2023). The themes were generated from the data and the research questions. Sanken diagram, word cloud, networks, tables and narratives were used to present the results.

Findings and discussion

The results are discussed based on the following themes: frequency of use, databases accessed, how self-confident, reasons for self-confidence, difficulties or challenges encountered and recommendations.

Demographics of the participants

The researchers examined the participants' demographic information according to programs and sex. The findings are seen in Table 1:

Table 1: Demographics and Codes for Participants

Program	Participant Code
Post-RN Bachelor of Science in Nursing	P1-P3, P5-P14, P19-P21, P23-P25, P27-P33, P49-P59
Post-RM Bachelor of Science in Midwifery	P4, P15-P18, P22, P26, P34, P48, P50, P55
Bachelor of Science in Nursing (Direct entry BScN)	P7, P13, P23, P35, P40, P45-P47

Fifty-seven participated in the study. As Table 1 shows, most of the participants were female. The three Nursing and Midwifery programs were represented in the study. The participants were coded for easy reference; the codes start from P1-P59, where P1 is Participant One, and P59 is Participant 59.

Frequency of use of online sources of Health Information

Participants were asked to declare their frequency of using the library. The outcomes reported that most participants used the online resources frequently, and very few used them rarely. The participants were also asked to mention the online health information sources they used most of the time. The results indicate that most of the participants mentioned the words Library and databases, which means they were the most known sources of health information, as seen in the Word Cloud Diagram in Figure 1. Furthermore, health websites such as Medknow.com and YouTube were also popular.

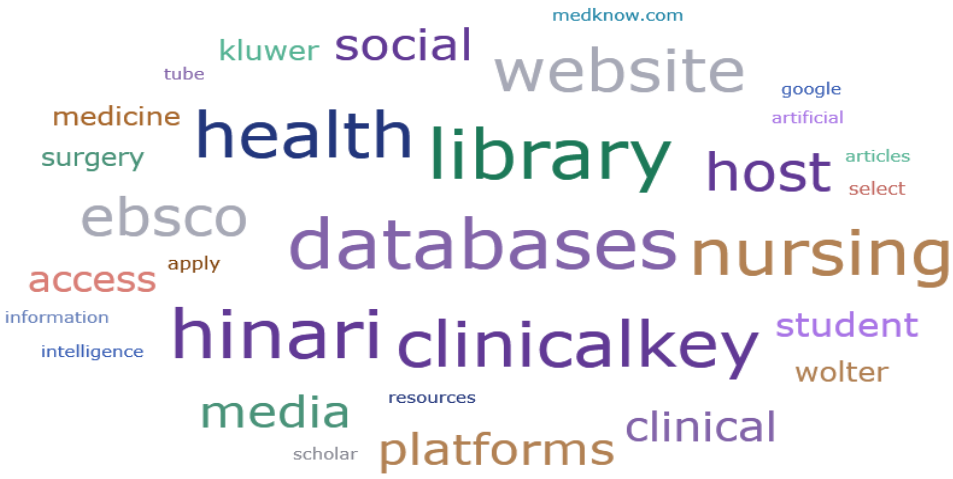

Figure 1: Word Cloud Showing the Sources of Health Information

The study participants mentioned frequently using HINARI, followed by EBSCO Host, Clinical Key, and Clinical Key Student Nursing, as seen in Figure 1. The databases provided by Aga Khan University Library contain an authoritative variety and vast clinical information. Students gain access to world-class, evidence-based journals, books, practice guidelines, patient education, clinical updates, drug information and the latest news and events in nursing and midwifery.

Access to online health resources and self-confidence

The results show that using online health information resources has increased self-confidence of nursing students. The participants expressed their opinion on how they felt; some said average, others said confident in specific percentages, others mentioned 75% and 70%, and others said very confident, as seen in Figure 2:

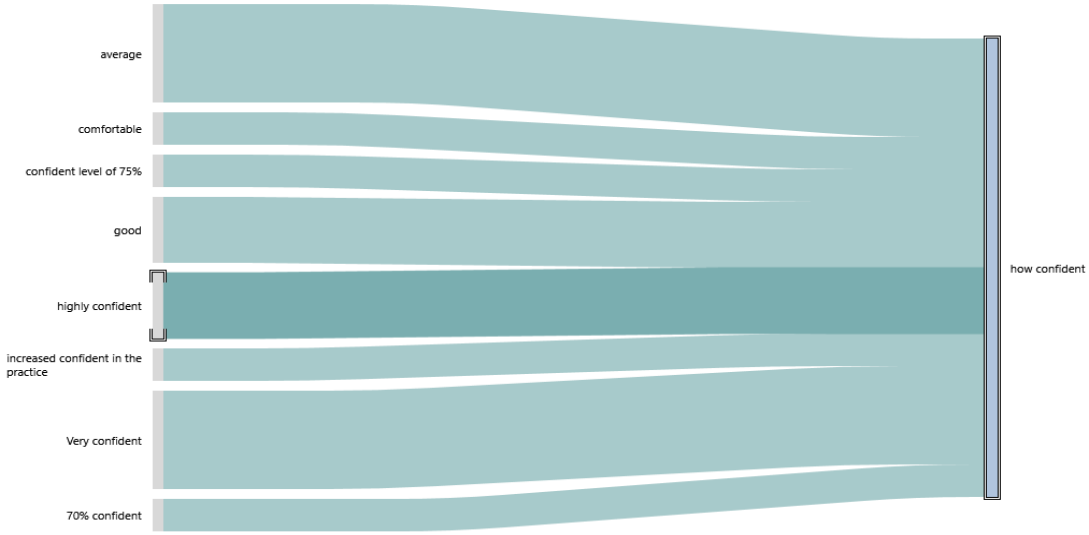

Figure 2: Usage of Online Health Information and Self-confidence

The results show that using online health information resources increased the self-confidence during examinations and at the point of care. Figure 2 shows that most participants expressed that they were very confident as they persistently used the resources the confidence was shaped. Some also did not feel so confident but mentioned being average; the reasons for being average were that they needed more training, connectivity and time to use and familiarize with the resources. Meanwhile, others expressed that contradicting information in some sources

made them lose confidence. These findings agree with those of Jang and Kim (2014), Tabriz *et al* (2024), and Laschinger *et al* (2008) that nursing and midwifery students' self-confidence was shaped when they kept on using online health information resources of various categories. Especially when the students were given ample time to navigate and interact with the resources and learn personally. These findings mean that the self-confidence of the students comes when they persistently use these resources and navigate in them themselves as they learn and acquire the knowledge and the skills. It also means that the students need to be given more time to utilize these resources. These findings about frequency and persistence used for self-confidence agree with those of Lai and Nalliah (2010) that the more they use the resources, the more they gain knowledge and skills.

Reasons for being confident

The researchers probed the participants further. They argued that they were confident and knew why they felt so. The results are shown in Table 2:

Table 2: Reason for Being Confident with Online Health Information

SN	Reason
1	Improve critical thinking
2	Give assurance of things and concepts.
3	Enhanced the ability to make informed decisions
4	Enhanced the ability to provide patient care support
5	Helped to stay current with the latest research and guidelines in the field.
6	Reliable and current information in the databases gives trust
7	They help to provide evidence-based care to patients.
8	Accessible all the time improves dependability
9	Provides extra knowledge in the process of nursing and midwifery practice
10	Gained a lot of knowledge and skills

Table 2 shows that students gained self-confidence in various ways as confirmed by the statements presented hereunder:

Critical thinking skills, "*Online health information resources have positively impacted my self-confidence. They have empowered me to explore various topics independently, deepening my understanding and enhancing my critical thinking skills*" (P58).

The student's confidence came from the knowledge and the skills acquired from these resources. "*I have gained a lot of knowledge, and it has helped me improve my knowledge and skills" (*P1).

Student made informed decisions confirmed in this statement from Participant Twenty-four,
"The *access to HINARI and evidence-based information has enhanced my ability to make informed decisions, support patient care, and stay current with the latest research and guidelines in my field*" (P24).

Boosted my confidence in handling complex assignments and making informed decisions in my studies (P44).

As mentioned by P35, students have gained knowledge to solve problems. "While initially, the abundance of information was overwhelming, with practice, I've become more adapted to identifying credible sources and applying the knowledge effectively in both academic and clinical settings.

Confidence in research:
"*It is easy to access materials anywhere through mobile phone, but I have also been updated with health information, especially excellent clinical research. This allowed me to grow in research and attend various scientific conferences, including within the country and outside*" (P43)

Difficulties experienced when accessing online health information
The participants were asked to mention difficulties encountered when accessing online health resources. The results are as seen in Figure 3:

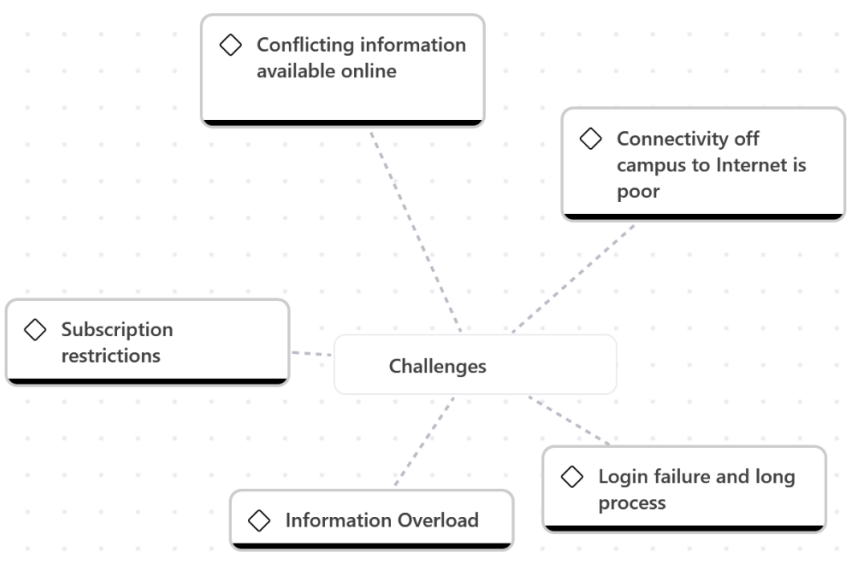

Figure 3*:* Difficulties Encountered on Accessing Online Health Information

The study participants expressed the challenges or difficulties they encountered when accessing the resources, as seen in Figure 3. One respondent says:

"*Information Overload: The vast amount of available information can be overwhelming, making it difficult to filter out the most relevant and reliable data*" *(*P2*).*

As seen in Figure 3, logging failure and a long process hindered students' proper use of the resources. These findings on challenges are not far from those of Oladipo et al. (2020), Olum *et al* (2020), and Rafi *et al* (2020), whose studies revealed that in Africa, a lack of reliable ICT facilities, including Internet connectivity, affected access and use of online health information by nursing and midwifery students. Even though universities provide access to online health information off campus through open Athens and other facilities, personal connectivity to these facilities was a challenge.

Recommendations

The participants were asked to give suggestions for improvement. The following are suggestions given:

i. Repackage the procedure in CD formation, which can be watched offline without the Internet.
ii. Librarians to conduct regular training / Tutorials and workshops for faculty and students.
iii. Implementing a feature for personalized resource recommendations based on specific course topics or assignments could also enhance the user experience for nursing students.
iv. Libraries should regularly assess and update their resources based on student feedback to ensure relevance.
v. Collaboration between librarians and nursing students is also crucial.
vi. Regular communication can raise awareness of available resources while integrating library materials into nursing curricula can streamline access.
vii. Developing mobile-friendly platforms and ensuring virtual access to databases will allow students to access resources easily anytime, anywhere.
viii. Regular communication can raise awareness of available resources.
ix. Extended orientation for new students to impact understanding to students at the very beginning so that students themselves can navigate online sources individually with time.
x. crating reliable resources, providing training, improving access, offering interactive learning tools, ensuring 24/7 support, and creating a feedback system.
xi. Create access to mobile phones

The participants said as seen in Table 3 for them to benefit more in these resources there should be regular training, personalized resources, regular assessment and updating of the resources, and use of mobile phone applications to ease the access.

Implication of the study

The study findings provide implication to the School of Nursing and Midwifery and the Library Management. They should put on a growing mindset as they interact with online health information which provides new knowledge and skills, also should persist in accessing and using the resources, practice what they have learnt to gain self-confidence. The School of Nursing and Midwifery should align the resources in the curriculum so that students always can go deeper into these resources and gain knowledge to build self-confidence. The School of Nursing and Midwifery should provide more time for the students to attend library training and navigate through the online health information for self-confidence. It should intensify training and provide personalized information according to the specific needs of the students. They should explore ways to repackage the information for easy access offline, probably through mobile applications. Likewise, the library should explore ways to have a single signing in to all the databases.

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Open Access Institutional Repositories Competence Level among Users for Improved Accessibility of Institutional Research Productivities: The Case of Selected Academic Institutions in Tanzania

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Abstract

OAIRs competence level among users plays a critical role in improving accessibility of institutional research productivities available in OAIRs. OAIRs competence enables easy use of OAIRs. However, in most of African institutions especially in Tanzania, the level of OAIRs competence among users in academic institutions is unknown. This study therefore was carried out to investigate the competency level in accessing institutional research productivities among users of academic libraries in Tanzania. Specifically, the study focused on examining the level of competency, assessing where users acquired skills of accessing institutional research productivities, establishing the attitude of library users towards acquiring skills and identifying constraints faced in acquiring OAIRs skills. The study employed a cross-sectional research design. Systematic random and purposive sampling procedures were used to obtain a total of 292 respondents and 8 key informants. Both quantitative and qualitative data were collected from academic staff, research fellows and librarians. Structured questionnaires, interview schedules and content analysis were used to collect data. Quantitative data were analyzed using SPSS package V20.0 while qualitative data were analyzed using content analysis. Key findings indicated that 28.4% of the respondents are computer competent, information search literate (27.1%), competent in communication skills (27.1%), and competent in scholarly publishing and self-archiving (20.5%). Results indicated that respondents acquired skills of accessing institutional research productivity from librarians (22.6%), and library technicians (18.2%). Also results revealed that 57.9% were positive towards acquiring skills and 56.9% agreed that acquiring skills of OAIRs facilitates free and quick access. However, lack of awareness on presence of OAIRs (38.6%), unawareness of OAIRs policy (22.8%) and lack of budget for training and advocacy of OAIRs (19.3%) were constraints faced in acquiring OAIRs skills. The study concluded that the competency level on accessibility of institutional research productivity is still low among library users, even as the use of OAIRs in Tanzania is still low. The study recommends reviewing OAIRs policies for managing OAIRs especially putting up mechanism for enforcing training

among users and investment in infrastructure for improved accessibility of institutional research productivity in Tanzania institutions.

Keywords: *Open Access Institutional Repository (OAIRs), Academic staff attitude, OAIRs competency level, Higher learning institutions, Tanzania.*

Introduction

Open Access Institutional Repositories (OAIRs) refer to a collection of full-text documents available in online databases in the Internet that can be accessed freely and instantly. OAIRs collect and preserve scholarly publications from members of various institutions. Bamigbola (2017) revealed that scholarly publications available in the OAIRs cut across many fields including theses, dissertations, projects, course notes, seminar papers, conference proceedings, administrative documents, learning objects and other forms of grey literature. These scholarly publications are collected, uploaded and disseminated to communities freely without any barriers.

To improve accessibility of institutional research productivities, competency among users is required. Currently, for better accessing different scholarly publications in OAIRs requires users to be proficiently competent. Users of OAIRs require a variety of skills to effectively navigate and utilize the resources available in OAIRs (Ladipos, 2022). These skills may include information retrieval skills, digital literacy, research skills, collaboration and networking skills and ICT skills. According to Bamigbola (2017) accessibility of institutional research productivities requires users to be skillful in digital literacy, media literacy skills and ICT competency. Moreover, Alhija and Majdob (2017) and Bamigbola (2017) averred that there is lack of skills among some lecturers which could undermine the accessibility of research productivities in OAIRs.

These skills can be acquired through various sources including library staff, colleagues and supervisors. Also, libraries and information centers can provide proper training to enhance knowledge and skills in accessing OAIRs research productivities. Users of OAIRs lack competency of accessing institutional research productivities, though they have positive attitude and interest of becoming competent in the use of OAIRs. However, confusion about where to acquire such skills discourages them. Notwithstanding, for OAIRs to successfully serve their potentials, users are called to be competent in accessing OAIRs research productivities.

Efforts of addressing the challenge of competency among OAIRs users such as training, formulation and implementation of OAIR policies as well as provision of funds have been provided by the institutions, yet the results did not yield a positive result in addressing the problem. Additional steps are needed to solve this situation. Library staff are also supposed to be competent to assist in delivering information services to users and training them on how to access OAIRs research productivities to obtain the information they need.

It avails to say that because various studies were done in relation to OAIRs competence in other countries. It is still needed to investigate more in Tanzania because there is low usage of OAIRs, as revealed by studies conducted by Mbughuni *et al* (2022) and Nunda and Elia (2019) who reported that there are various OAIRs establishment in Tanzania, but still potential users have not yet fully explored them. It is on this basis that this study was undertaken to investigate the OAIRs competency level among users in accessing OAIRs research productivities in academic institutions in Tanzania.

Problem statement

OAIRs competency among users is important for improved accessibility of institutional research productivities. According to Shahla (2019), such productivities enhance teaching, learning and research. They also increase citation and prestige among academic staff. For library users to enjoy the benefits of OAIRs they are required to possess enough knowledge and skills for full utilizations. However, in most African institutions especially in Tanzania, the level of OAIRs competency among users in academic institutions is unknown (Mbughuni *et al.,* 2022; Mwalubanda, 2021; Kayungi *et al.,* 2021; Elia & Nunda, 2019; Malekani & Kavishe, 2018). Therefore, this study was carried out to investigate the competency level in accessing institutional research productivities among users of academic libraries in Tanzania.

Objective of the study

This study was carried out to investigate the competency level in accessing institutional research productivities among users of academic libraries in Tanzania. Specifically, the study sought to address the following objectives:

i. To find out the competency levels of staff on accessing OAIRs,

ii. To identify means through which the staff acquire skills on accessing OAIRs,
iii. To assess the attitudes of staff on acquiring skills on OAIRs,
iv. To examine constraints facing staff on acquiring skills on OAIRs.

Literature review

Competence level on the accessibility of institutional research productivities

Unexpectedly, previous studies found out that various users of OAIRs in academic institutions were not very conversant or competent on accessing institutional research productivities uploaded in OAIRs. Ratanya (2017) and Chilimo (2016) conducted studies on institutional repository focusing access and use. They found associated low use and difficulties in self-archiving practices with incompetence among users of OAIRs. Another study by Solomon and Soyemi (2021) and Nagappa and Santhosh (2020), revealed that most OAIRs users lack ICT skills; therefore, it becomes very difficult for them to access research productivities uploaded in OAIRs. This implies that various OAIR users are not competent and training to enhance competence on the accessibility of institutional research productivities in OAIRs among academic staff are rarely conducted.

On the other hand, librarians who are also academic staff were found to be more competent in accessing open access databases such as repositories than other academic staff. This situation is related to the fact that librarians are custodians of repositories; so, apart from experience they attend training regularly. This makes them more competent than other academic staff. Baro *et al* (2019) emphasized that librarians have been trained on how to access institutional research outputs available in OAIRs, therefore their level of digital literacy skills is reasonable.

To eliminate deficiency in competency among OAIRs users several studies reported that various institutions should try to impart knowledge and skills on how to access institutional research productivities uploaded in OAIRs especially among academic staff. Kayungi *et al* (2021) reported that academic staff should be imparted with skills to be competent in accessing institutional research productivities. Without competency in the accessing institutional research productivities, OAIRs will not be used.

Skills to access institutional research productivities of OAIRs

To access institutional research productivities uploaded in OAIRs it requires different skills such as digital literacy, media literacy and ICT skills. Unexpectedly, various studies found that users of OAIRs in academic institutions do not have enough skills to access institutional research productivities uploaded in OAIRs. Ratanya (2017) associated low use and difficulties in self-archiving with the lack of skills on the use of OAIRs. Similar studies on the skills required for using OAIRs among academic staff revealed that most OAIRs users do not have enough skills such as digital literacy, media literacy and ICT skills. Therefore, it is very difficult for them to know how to access institutional research productivities uploaded in OAIRs. Yet, training to enhance skills on the accessibility of institutional research productivities uploaded in OAIRs among academic staff were reported to be rarely conducted (Solomon and Soyemi, 2021; Nagappa and Santhosh, 2020).

To eliminate deficiency in skills studies reported that different institutions should try to impart skills on how to access institutional research productivity in OAIRs to users, especially academic staff from different sources. Kayungi *et al* (2021) reported that libraries should impart skills by training and conducting different workshops. Colleagues and supervisors who have skills should impart to their fellows. In this regard, skills on accessibility of institutional research productivities in OAIRs will ensure accessibility of institutional research productivities uploaded in OAIRs. Also, library management should equip librarians with necessary skills to be able to offer services to users. According to Ngure and Gatiti (2015), conducting skills training to staff ensures they are competent for the benefit of their users.

Attitude of library users towards acquiring skills

The attitude of academics towards acquiring new skills may be positive or negative depending on the approach adopted by the institution. Ukwoma and Dike (2017) pinpointed that the attitude of acquiring skills of using OAIRs will depend on how useful the OAIRs has proved to their colleagues. Users of OAIRs may have more or less positive attitude towards acquiring skills related to access of institutional research productivities if OAIRs are effectively operated. According to Sankar and Kavitha (2018) users have positive attitude in acquiring skills because they are eager to be proficient with OAIRs to enhance their research capabilities and visibility. Other users of OAIRs have positive attitude towards

acquiring skills of using OAIRs because they want recognition, uploading their research output in OAIRs can add value in their works, such as increased citations, compliance with funder mandates, and preservation of research outputs.

Namugera *et al* (2023), revealed that academics have positive attitude in acquiring related skills to access institutional research productivities in OAIRs because using OAIRs motivates/ promotes efficiency, saves time and improves discoverability of their research. Also, other users have positive attitude in acquiring skills because the use of OAIRs minimizes challenges and gives support in the form of user guides, workshops and help desks (Sankar *et al*., 2018). Overall, attitude of library users towards acquiring skills vary but generally lean towards seeing repository skills as beneficial and worth investing time in mastering (Jayakananthan *et al*., 2023).

Constraints facing users when trying to acquire OAIRs skills

Users have been encountering several problems when trying to acquire skills of accessing institutional research productivities uploaded in OAIRs. Most users who are academicians are busy and find it difficult to allocate time for learning new skills related to access of institutional research productivities in OAIRs. Ukwoma and Ngulube (2019), pinpointed that lack of training resources makes it difficult to access institutional research productivities in OAIRs. In institutions there are insufficient training resources such as tutorials and documentation to help users learn how to use the repository effectively.

According to Saliu *et al* (2022), technical challenges is one of the factors that users face when trying to acquire OAIRs skills. Most users encounter user interface, technical support or issues with repository software that hinder their ability to access institutional research productivities in OAIRs. Ladipo *et al* (2022) revealed that lack of awareness and motivation on the benefits of using OAIRs may discourage efforts to help them learn how to access institutional research productivities in OAIRs. Also, accessibility challenges, such as language barriers, lack of assistive technologies or non-inclusive training materials, can prevent some users from acquiring necessary skills. Understanding issues such as OAIRs policies, copyright issues and institutional mandates can be complex and daunting for users, creating an additional barrier to learning how to access institutional research productivities in OAIRs.

According to Tenya *et al* (2023), insufficient resources is another constraint facing OAIRs users when trying to acquire OAIRs skills. For instance, limited access to computers, unreliable internet connections or other necessary technology can be a significant barrier for some users. Also, support availability and responsiveness of support staff can vary, and insufficient support can leave users struggling to overcome obstacles on their own. Moreover, addressing these constraints involves providing comprehensive training resources, simplifying repository interfaces, raising awareness of the benefits and offering robust support systems to ensure users can effectively utilize institutional repositories (Ukwoma and Ngulube, 2019).

Strategies to improve competency of accessing institutional research productivities

Several studies have underscored the strategies for improving competency in accessibility of institutional research productivity in OAIRs (Ezma and Eze, 2024; Baro, 2023; Saliu *et al*., 2022 and Kodua-Ntim, 2021). The study conducted by Ezma and Eze (2024) revealed that to improve OAIRs competency level among users for accessibility of institutional research productivities users should be equipped with the skills and knowledge needed. According to Saliu *et al* (2022) there is a need of providing regular training sessions and workshops focused on accessibility, best practices in research, including how to publish in open-access journals, use accessible data visualization techniques and create accessible documents. This will ensure that all staff and researchers are up to date on the latest accessibility standards and practices, leading to more consistent and inclusive research output.

The study done by Ukachi (2018) emphasized that creating awareness on the availability and accessibility of the scholarly materials in the institutional repository platform is one of the strategies adopted by the libraries in promoting scholarly communication. This can be done by integrating accessibility training into the research methodology courses or professional development programs offered by the institution. As a result, it will embed accessibility as a core competency for emerging researchers, ensuring that new graduates are prepared to produce and disseminate accessible research. According to Baro *et al* (2023) revealed that a few IR have a clearly defined access policy therefore institutions should develop institutional policies that mandate or encourage accessible research practices, such as requirements for accessible formats or incentives for

publishing in open-access journals. Mbughuni *et al* (2022) and Kodua-Ntim, 2021, found out that incentives, recognition and reward to researchers who excel in making their work accessible will clear expectations and provide motivation for researchers to prioritize accessibility, leading to more widespread adoption of accessible practices across the institution.

Also, Kari and Orji (2022) explained that establishing mentorship programmes will enable experienced researchers who are knowledgeable about accessibility to guide and support less experienced colleagues. This will facilitate the sharing of expertise and resources, helping to build a community of researchers who are competent in accessibility and can support each other's growth. These strategies can significantly enhance the competency of researchers and staff in making institutional research more accessible, ultimately leading to improved accessibility of institutional research productivity.

Materials and methods

The study area were four selected public universities in Tanzania namely, Mzumbe University (MU), Muhimbili University of Health and Allied Sciences (MUHAS), Sokoine University of Agriculture (SUA) and the University of Dar es Salaam (UDSM). These universities were selected because they have operational OAIRs which are used by academic staff members and researchers. Therefore, they were believed to provide the needed data. A Cross-sectional research design method was employed. Systematic random and purposive sampling were techniques used in this study. In systematic random sampling, every 6th academic staff member was picked from the list of academic staff members to obtain a representative in each selected university. Purposive sampling technique was used to acquire eight key informants (Heads of Department, ICTs and Library Technicians) from the four universities. Key informants were selected to provide information concerning the level of competency among users of OAIRs. The population included 2894 respondents who were academic staff members from four selected public universities, and the sample size was 413 academic staff members obtained by using the formula known as Slovin's (n=N/ (1+Ne2)). See the sampling frame in Table 1:

Table 1: Sampling Frame

	MUHAS	MU (Main campus)	SUA (Only Main campus and SMC)	UDSM (Main campus)	Total
Academic staff population (N)	693	236	427	1538	2894
The proportion from the required 'n' (N/2894) * *413*	99	34	61	219	413

Source: Mbughuni *et al* (2022)

The study collected quantitative primary data through structured questionnaire distributed to 413 academic staff, that is MUHAS (77), MU (47), SUA (43) and UDSM (125). A total of 292 questionnaires were filled out and returned making a return rate of 70.7 per cent. Qualitative primary data were collected through interviews with key informants (Four heads of departments, two ICT technicians and two library technicians). Also, universities' OAIRs documents to understand the concept of the study and existing literature on the level competency among users of OAIRs to get an overview were used to collect secondary data.

Quantitative data was analyzed using Statistical Product and Service Solutions (SPSS) 20th version. Descriptive statistics were calculated to generate frequencies and percentages. Qualitative data was analyzed by using content analysis. Data obtained from the interviews and other sources were organized into similar themes which were addressed in a certain situation and presented in the form of explanations.

Results

Number of respondents in each university

Figure 2 shows the number of academic staff in each university. The findings indicate that 42.9 percent of the respondents were from UDSM, 26.4 percent from MUHAS, 16.1 percent from MU and 14.7 percent from SUA. The number of respondents demonstrates that the present study managed to have ample and appropriate respondents to address its objectives. of the academic staff are aware of the advantage of having OAIRs in the institution and they have positive attitude on the accessibility of research productivity in OAIRs.

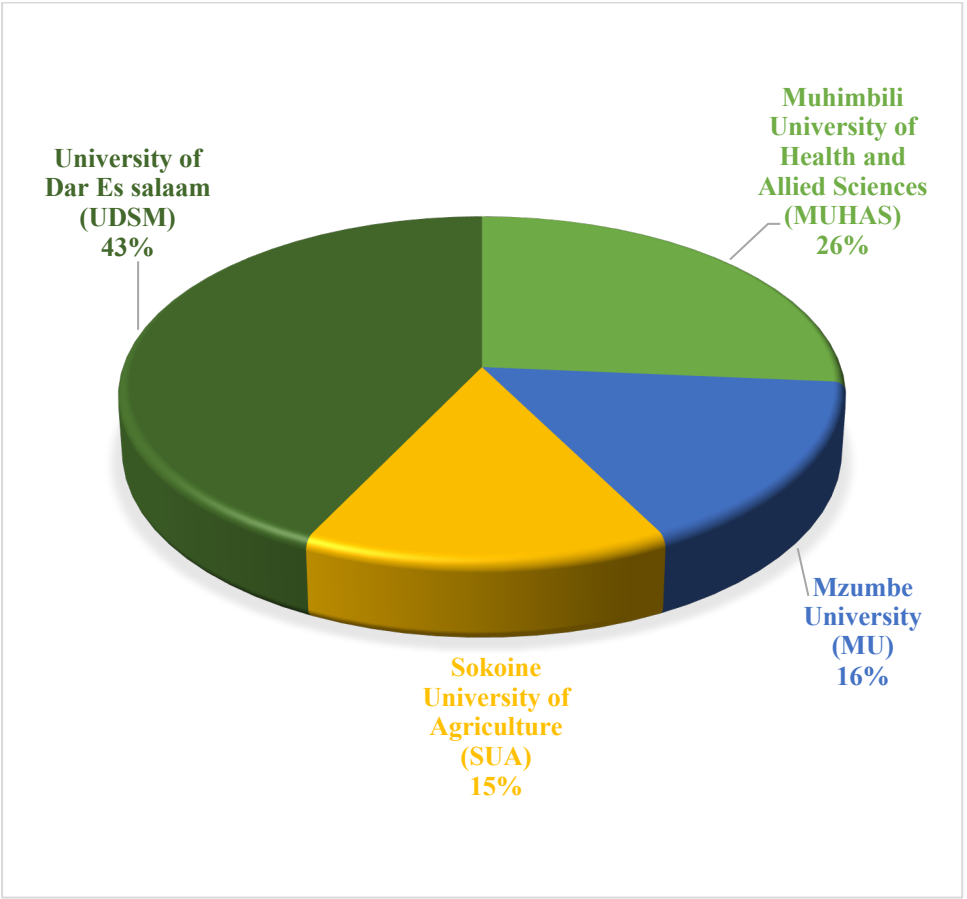

Figure 1: Number of Respondents in the Selected Universities (n=292)
Source: Field Data (2020)

Demographic characteristics and the level of competence and accessibility of OAIRs research productivity

Table 2 shows the influence of demographic characteristics on the level of competence and accessibility of OAIRs research productivity. The results show that 52.3% of male respondents access more of research productivity in OAIRs than female respondents. 45.5% of respondents with age between 36 and 45 access more research productivity in OAIRs. Respondents with master's degree (40.6%) were found to access more research productivity in OAIRs, while 43.7% of lecturers indicated access to more research productivities in OAIRs and 50.7% of respondents with working experience of 11-15 years found to access more research productivities in OAIRs.

Table 2: Demographic Characteristics and Competence to Use OAIRs (n=292)

	Have you ever accessed research outputs in university's OAIR?			
	Yes	**No**	**Total**	**p-value**
Sex of respondent				
Male	92 (52.3%)	84 (47.7%)	176 (100.0%)	.011
Female	43 (37.1%)	73 (62.9%)	116 (100.0%)	
Total	135(46.2%)	157(53.8%)	292 (100.0%)	
Age of respondents				
20-35	30(36.6%)	52 (63.4%)	82 (100.0%)	.003
36-45	50(45.5%)	60 (54.5%)	110 (100.0%)	
46-50	24(45.3%)	29 (54.7%)	53 (100.0%)	
51-60	18(54.5%)	15 (45.5%)	33 (100.0%)	
61 and above	13(92.9%)	1 (7.1%)	14 (100.0%)	
Academic qualification				
PhD	53(54.1%)	45 (45.9%)	98 (100.0%)	.181
Masters	54(40.6%)	79 (59.4%)	133 (100.0%)	
Bachelor	27(47.4%)	30 (52.6%)	57 (100.0%)	
Post Graduate Diploma	1(25.0%)	3 (75.0%)	4 (100.0%)	
Academic rank				
Tutorial assistant	18 (45.0%)	22 (55.0%)	40 (100.0%)	.000
Assistant lecturer	27 (29.7%)	64 (70.3%)	91 (100.0%)	
Lecturer	31 (43.7%)	40 (56.3%)	71 (100.0%)	
Senior lecturer	12 (48.0%)	13 (52.0%)	25 (100.0%)	
Associate professor	7 (87.5%)	1 (12.5%)	8 (100.0%)	
Professor	14 (100.0%)	0 (.0%)	14 (100.0%)	
Librarian trainee	3 (37.5%)	5 (62.5%)	8 (100.0%)	
Assistant librarian	6 (60.0%)	4 (40.0%)	10 (100.0%)	
Librarian	5 (100.0%)	0 (.0%)	5 (100.0%)	
Senor librarian	2 (40.0%)	3 (60.0%)	5 (100.0%)	
Other ranks	10 (66.7%)	5 (33.3%)	15 (100.0%)	
Working experience (yrs)				
1-5	25 (32.1%)	53 (67.9%)	78 (100.0%)	.002
6-10	27 (39.7%)	41 (60.3%)	68 (100.0%)	
11-15	38 (50.7%)	37 (49.3%)	75 (100.0%)	
16-20	20 (55.6%)	16 (44.4%)	36 (100.0%)	
21-25	11(64.7%)	6 (35.3%)	17 (100.0%)	
26 and above	14 (77.8%)	4 (22.2%)	18 (100.0%)	

Source: Field Data (2022)

This implies that sex, age, level of education and working experience were found to have a 5% level of significance (p-value≤0.005).

One qualitative result from key *informant narrated that:*
"Generally, most of those accessing research productivity in OAIRs are young academic staff."

Competency level on accessibility of institutional research productivities

Table 3 presents the competency level on accessibility of institutional research productivities in OAIRs among users. Results show that 28.4% of the respondents were computer competent, information search literate (27.1%), skilled in communication (27.1%), understanding Open Access copyright issues, licensing (e.g., creative commons) and familiar with intellectual property rights (21.9%), able access institutional research productivities (21.6%) and competent in scholarly publishing and self-archiving (20.5%). This implies that OAIRs users are competent in terms of having basic skills and knowledge on the accessibility of institutional research productivities in OAIRs.

Table 3: Competency Level on Accessibility of Institutional Research Productivities (n=292)

Competency	Adequate	Neutral	Inadequate	p-value
Able access institutional research productivity	63 (21.6)	52 (17.8)	20 (6.8)	0.114
Understanding of Open Access copyright, licensing and intellectual property rights	64 (21.9)	49 (16.8)	21 (7.2)	0.009
Communication skilled	79 (27.1)	34 (11.6)	22 (7.5)	0.000
Scholarly publishing or Self-archiving	60 (20.5)	52 (17.8)	23 (7.9)	0.114
Computer competent	83 (28.4)	39 (13.5)	13 (4.5)	0.000
Information search literate	79 (27.1)	40 (13.7)	16 (5.5)	0.000

Source: Field Data (2022)

The results show that communication skilled, computer competent and information search literate have a 5% level of significance (p-value≤0.005). This means there is a relationship between communication skilled**,** computer

competent and information search literate and accessibility of institutional research productivities.

Three qualitative results from key informants narrated that:
"*Competency is the most important aspect on accessibility of institutional research productivities in OAIRs, lucky enough our OAIRs users have skills and are capable of navigating or accessing content available in our OAIRs"* (Key informant 1, 2022).

"Lecturers are more competent in accessing content in OAIRs rather than self-archiving their research productivities" (Key informant 1, 2022).

"Junior staff are more competent in accessing of institutional research productivities than senior academic staff, this is because young generation are more capable of using technology than the old generation" (Key informant 1, 2022).

Sources of skills acquired for accessing institutional research productivities
Table 4 shows the results of where OAIRs users acquired skills of accessing institutional research productivities. The results indicated that users reported to acquire skills of accessing institutional research productivities from librarians (22.6%), and library technicians (18.2%). Others indicated to acquire from Internet (15.4%), colleagues (10.3%), OAIRs guide (9.6%), and ICT technicians (5.5). These results imply that most of the OAIRs users acquired skills of accessing institutional research productivities from various sources including library staff and library technicians.

Table 4: Sources of Skills Acquired (n=292)

Source	Frequency	Percentage (%)
Librarians	66	22.6
Library technicians	53	18.2
ICT technicians	16	5.5
Colleagues	30	10.3
Internet	45	15.4
OAIRs guide	28	9.6

Source: Field Data (2022)

Qualitative results from a key informant narrated that:

"*There are other researchers who are not competent in accessing institutional research productivities and sometimes librarians are so busy with other activities; therefore, they fail to assist them. Therefore, it is better to prepare seminars or training to teach them on how to access research outputs available in OAIRs"* (Key informant 1, 2022).

Attitude of library users towards acquiring skills of accessing institutional research productivities

Table 5 shows the results on the attitude of academic staff towards acquiring skills of accessing institutional research productivities in the selected higher learning institutions. The results indicated that 57.9% were positive towards acquiring skills, while 56.9% agreed that acquiring skills of OAIRs facilitates free and quick access. Those who agreed that it is wise to decide on accessing institutional research productivities in OAIRs were 52.6% In addition, 66.7% agreed that acquiring skills improves knowledge and skills of using electronic resources whereas 47.3% agreed that acquiring skills is favourable for them. Those who agreed that acquiring skills makes them feel easy and comfortable were 52.6% and those who indicated that it is beneficial academically to acquire skills were 56.1%. This means that most users have a positive attitude towards acquiring skills of accessing institutional research productivities in OAIRs.

Table 5: Attitude towards Acquiring Skills of Accessing Institutional Research productivities (n=292): multiple responses from respondents

Attitude	Agree	Neutral	Disagree
I am positive towards acquiring skills	33 (57.9%)	14 (24.6%)	10 (17.6%)
Acquiring skills facilitates free and quick access to publications	34 (56.9%)	14 (24.6%)	9 (15.8%)
It is wise to decide on acquiring skills	30 (52.6%)	16 (28.1%)	11 (19.3%)
Acquiring skills improves use of electronic resources	38 (66.7%)	12 (21.1%)	7 (14.3%)

Acquiring skills is favourable for me	27 (47.3%)	21 (36.8%)	9 (15.8%)
Acquiring skills makes me feel at easy and comfortable	30 (52.6%)	11 (19.3%)	16 (28.1%)
It is beneficial academically for me to acquire skills	32 (56.1%)	10 (17.3%)	15 (26.3%)

Source: Field Data (2022)

Qualitative results from a key informant narrated that:
"*Other researchers they don't prefer to acquire skill of accessing institutional research productivity because they have a notion that the research productivities available in OAIRs are outdated or they are of low quality*." (Key informant 1, 2022).

Constraints facing users when trying to acquire OAIRs skills

Table 6 shows the results on the constraints faced when trying to acquire OAIRs skills among users in selected higher learning institutions. The results indicated that the major constraints reported by respondents include lack of awareness on presence of OAIRs policy (38.6%), lack of interest and fear of accessing institutional research productivities in OAIRs (22.8%) and lack of budget for training and advocacy of OAIRs (19.3%). Others included inadequate training (10.5%), lack of infrastructure and network facilities (14.0%), shortage of competent librarians (8.8%), non-availability of consultation services (5.3%) and lack of updating training strategies on OAIRs (12.3%). This implies that there are several factors which hinder OAIRs users when trying to acquire OAIRs skills of accessing institutional research productivities in higher learning institutions.

Table 6: Constraints Facing Users in Acquiring OAIRs Skills (N= N=292)

Constraint	Frequency	Percentage
Lack of budget for training resources and advocacy of OAIRs	11	19.3
Inadequate training on the accessibility of OAIRs	6	10.5
Lack of infrastructure & network facilities	8	14.0
Lack of competent library staff for providing training on the OAIRs acquiring skills	5	8.8
Time limitations	3	5.3
Lack of updating training strategies on OAIRs	7	12.3

Lack of interest and fear of OAIRs acquiring skills	13	22;8
Lack of OAIRs policy	22	38.6

Source: Field Data (2022)

Qualitative results from one key informant narrated that:
"*Other researchers reported that, they are facing different constraints when trying to acquire OAIRs skills such as poor ICT infrastructure and unconducive environment" (*Key informant 1, 2022).

Strategies to improve accessibility of institutional research productivities

Table 7 shows the strategies to improve accessibility of institutional research productivities. The results indicated that strategies to improve accessibility of institutional research productivities mentioned by respondents included accessibility of audits and feedback **(**24.7%), provision of training and workshops (24.3%) and incorporating accessibility into research curriculum (20.2%). Others included mentorship and peer support (12%), providing incentives (5.8%) and policy development (5.5%). This means that there is a need to improve accessibility of institutional research productivities in OAIRs.

Table 7: Strategies to Improve Accessibility of Institutional Research Productivities (N=292)

Strategy	Frequency	Percent	Pvalue
Accessibility of Audits and Feedback	72	24.7	0 .607
Training and Workshops	71	24.3	
Incorporating Accessibility into Research Curriculum	59	20.2	
Mentorship and Peer Support	35	12.0	
Providing Incentives	17	5.8	
Policy Development	16	5.5	

Source: Field Data (2022)

Qualitative results from one key informant narrated that:
"*Mentoring is one of the most important strategies to improve accessibility of institutional research productivity. Mentors support and facilitate the achievement of scholars' goals"* (Key informant 1, 2022).

Discussions

The findings of the study show that demographic factors such as sex, age, education level and working experience significantly affect academic staff's access to institutional research outputs available in OAIRs. Older academic staff may experience technophobia, while younger staff members tend to be more enthusiastic about using new technology. Additionally, those with longer working experience are generally more skilled on accessing OAIRs than their junior counterparts. Consequently, institutions should offer greater motivation, assistance and support to staff who face challenges in accessing institutional research productivities available in OAIRs. The study also found out that academic staff are competent in terms of having basic computer skills on how to access institutional research productivities, file management and Internet browsing; they are informed on how to locate, evaluate and use information effectively, including understanding the ethical use of information and communication skills, ability to communicate with repository administrators, librarians or IT staff for support or assistance. However, the study found out that users lack enough competency in publishing or self-archiving, utilizing the Open Access Institutional Repository (OAIRs) and knowledge of open access principles, including copyright, licensing (e.g., creative commons) and intellectual property rights. The results of this study conform with Okoroma (2018) who opined that competency in using OAIRs is a critical factor that influences academic staff's abilities to successfully access institutional research productivities, as noted in Nigeria where lecturers were either unfamiliar with the term IR or had very little level of knowledge on the aims and objectives of IR, and therefore underutilized IR.

Furthermore, the study found that users of OAIRs acquired skills of accessing institutional research productivities from library staff and library technicians. This is possible because library staff are the custodians of OAIRs, capable of teaching how to use OAIRs. Therefore, it is easy for users to ask for help whenever they need. The results of this study differ with those of Antidius (2018) who revealed that most academics acquired skills from job training, in house classrooms training, local workshops/seminars and professional training and from library staff. However, it could be good for OAIRs users to acquire skills from other groups such as ICT technicians who could provide technical skills which will help

them in accessing scholarly publications found in OAIRs. Technical skills are very important as it was found out by Ukwoma and Ngulube (2019) that the major barrier on the access of institutional research productivities is lack of technical skills.

Also, the findings of the study showed that users of OAIRs had a positive attitude towards acquiring skills to access institutional research productivities. The results of this study conform with those of Wambui and Mutwiri (2022), who found that academic staff have a positive perception towards acquiring skills although self-archiving is yet to be embraced by a significant number of academic staff. Therefore, university and library management should continue to create awareness and training to increase positive attitude towards acquiring skills of accessing institutional research productivities among academic staff.

The findings of the study showed that users of OAIRs faced various challenges when trying to acquire skills of accessing institutional research productivities. The inhibiting challenges were lack of awareness on presence of OAIRs policy, lack of interest and fear of using OAIRs and lack of budget for training and advocacy of OAIRs. Others included inadequate training, lack of infrastructure and network facilities, shortage of competent librarians, non-availability of consultation services and lack of updating training strategies on OAIRs. The results of this study concur with those of Ukwoma and Ngulube (2019) and Kumah and Filson (2021) who reported that the major barriers are inadequate infrastructures, lack of awareness and sensitization and lack of technical skills.

Moreover, the study provides various strategies to improve accessibility of institutional research productivities, including provision of regular training sessions and workshops to ensure users are up to date on the latest accessibility standards and practices. Provision of training to users, mentorship programmes to impact skills and developing OAIRs policies are essential for institutions, especially those that lack availability of full-text research materials.

Conclusion

OAIRs in libraries make user community get free and instant research publications from a variety of scholars and make them updated with latest

publications for academic purposes. Despite having OAIRs and positive attitude among users, they still lack competencies which hinder the proper accessibility of OAIRs. Hence, library management should improve constraints that hinder effective access of institutional research products in OAIRs. It can be done through providing regular training programmes to impart competency and skills to library users for improved accessibility of institutional research products.

Recommendations

a) Provision of training to impart skills on accessing OAIRs
   Library management should provide training programmes to impart competency and skills to library users to be able to access OAIRs content and offer better and quality library services. Competency and skills can be provided through seminars, conferences and workshops and other special programs to update their knowledge and skills.
b) Rewarding academic staff who deposit their outputs on OAIRs
   University management may consider also rewarding academic staff who deposit their outputs in institutions' OAIRs in form of either up the ladder points or financial rewards. This will give OAIRs users positive attitude towards accessibility of OAIRs products and so increase usage of OAIRs.
c) Allocating enough funds for ICT infrastructure development
   Library management should make sure they allocate enough funds to develop ICT infrastructures, provide enough training to librarians and other staff and formulate OAIRs policy which will maximize accessibility and availability of full-text research.

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Libraries as Catalysts for Health Sector Development: Insights from a Systematic Review

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Abstract
Libraries are valuable sources of health information required for diagnosis, treatment and prevention of diseases. Numerous studies have shown that libraries enhance access to and dissemination of health information, which is crucial for health sector development. Despite the importance and rapid growth of research in the field, researchers have made few attempts to systematically review and incorporate findings from previous studies on the role of libraries in health sector development. The main purpose of this study was to provide a better understanding and a detailed review of the current state of research on the contribution of libraries in health sector development. A systematic review was conducted using the PRISMA 2020 Methodological Framework. In this systematic review, data on the role of libraries in health sector development were collected, analyzed and synthesized from journal articles published in digital databases between 2014 and 2024 using prescribed procedures. The research field, publication dates, journal language and methodological characteristics were included in the analysis. The findings indicate that libraries contribute to health sector development through the dissemination of health information required for the prevention and management of diseases, health professionals' development, promotion of health science research and community outreach programmes. Overall, the review indicated that several studies have been conducted on the role of libraries in healthcare settings, with most of them focusing on educational health institutions. Although these studies are relevant to the development of the health sector, more high-quality research is needed to focus on economic development aspect of the health sector.

Keywords: *Libraries, Library services, Health services, Health sector, Development, Medical libraries, Health institutions*

Introduction

Within the health sector, the Sustainable Development Goals (SDGs) aspire to guarantee healthy lives and well-being for all people by 2030 (WHO, 2024). The global target is to attain the quality of life for all people in all aspects of life by 2030. The SDGs thus, aim to improve the quality of life for all through initiatives focused on poverty reduction, ensuring food security, providing access to quality education, delivering comprehensive health services and fostering development

in other sectors (Morton *et al.*, 2017). It is believed that progress in the health sector will help countries attain other sustainable development goals (WHO, 2024). This implies that development in the health sector is a catalyst to overall national development.

Attaining SDG 3 necessitates the accessibility of reliable health information for both healthcare providers and the general community. Evidence from recent studies indicates that health information accessibility has substantial contributions to health sector development (Ayungo, 2024; Manyazewal, 2017). Studies (see for instance, Manyazewal, 2017) have also shown that health information is essential for strengthening health systems. Additionally, Wude *et al* (2020) found that routine utilization of health information by health workers improves health services and foster overall development within health sector.

Researchers have reported that libraries and information centers provide high-quality health information for health workers and the general community. For example, Okafor *et al* (2023) and Wude *et al* (2020) have reported that libraries play an important role in strengthening the health sector through provision of more reliable health information. Likewise, Jan *et al* (2021) reported that medical libraries contribute to the development of health sector by supporting clinical decision making. The findings from the aforementioned studies indicate that the contribution of libraries to the health sector is essential. This support is crucial for the sector to effectively achieve the Sustainable Development Goals (SDGs) by the year 2030.

Despite the extensive body of research demonstrating that libraries play a vital role in providing and distributing health information essential for the advancement of the health sector, there has been a notable lack of systematic reviews by researchers to synthesize and integrate insights from earlier studies regarding the contributions of libraries to health sector development. Consequently, the present study sought to provide a better understanding and a detailed review of the current state of research on the contribution of libraries to health sector development by addressing the following questions:

a) What is the role of libraries in providing access to health information and resources?
b) What is the impact of library services on healthcare education and training?
c) How effective are library outreach programs in promoting public health?

d) How do libraries collaborate with healthcare institutions in enhancing health sector services?

Methods

Study design

A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Framework (Khan *et al.*, 2003). The study followed five steps, namely formulation of research questions for review, identification of relevant literature, assessing the quality of studies and selection of relevant literature, summarizing the evidence and interpretation of the results.

Identification of relevant literature

The literature reviewed in this study was identified through searching across various online databases. The following online databases were used: Web of Science, PubMed, Semantic Scholar and Research4Life. The search terms used were "health libraries", "medical libraries", development, "health sector" and "library roles". Boolean operators AND, OR and NOT, alternative spelling, synonyms and narrower terms were applied during the search.

All publications identified through database search were subjected to inclusion criteria. A researcher and independent librarian searched through the databases using stipulated key terms and techniques. Two sets of publications retrieved through databases searched by the researcher and independent librarian were compared. Duplicate publications and those that did not meet inclusion criteria were omitted. Finally, 14 publications that were obtained through database search were included in the analysis.

Eligibility criteria

The study included original qualitative and quantitative publications that met the following criteria: time frame (studies published from 2014 to 2024), original publications (literature that reported primary data) and literature published in the English language.

Exclusion criteria

The following criteria were used to exclude publications from the study: time (studies published before 2014), studies published in a language other than English, publications in which full text were inaccessible, and studies that did not

report primary data such as systematic reviews and meta-analysis. The study also excluded non-original publications such as opinion pieces, review articles, commentaries, editorials and theoretical papers.

Data extraction and analysis

Data was extracted from all publications included in this systematic review. Extracted data was recorded in an Excel spreadsheet under the following headlines: title and author, date of publication, language of publication, objectives of the study, originality of the study, study findings and conclusion.

Data extracted from the reviewed publications were analyzed to identify the roles of libraries in providing access to health information and resources, impact of library services on healthcare education and training, effectiveness of library outreach programs in promoting public health and collaboration of libraries and healthcare institutions in enhancing health sector services.

Quality Assessment

To ensure the validity and reliability of the study, the quality of the selected studies was assessed using the Mixed Method Appraisal Tool (MMAT) as recommended by Archibald *et al* (2021).

Results

Figure 1 illustrates the flow of information through each phase of systematic review. Overall, 3817 publications were obtained through database search, and 91 publications were obtained through citation screening, making a total of 3908 records retrieved. After removing the duplications and screening for eligibility criteria, 14 publications met the inclusion criteria and were included in the analysis. Data were analyzed using thematic analysis and narrative approach as postulated by Popay *et al* (1998) and Popay *et al* (2016). Results are presented following research questions:

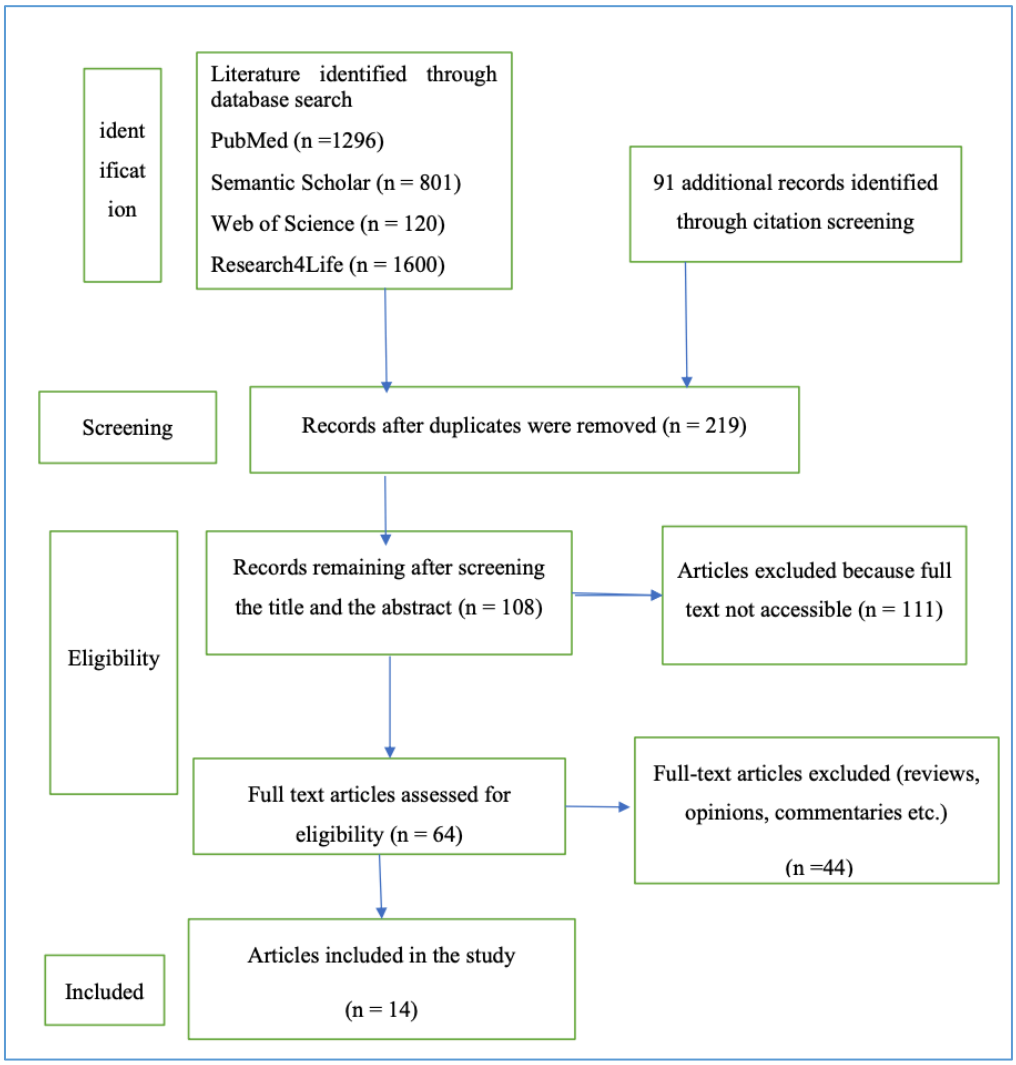

Figure 1: PRISMA Flow Diagram for Systematic Review

Role of libraries in providing access to health information and resources

Seven studies reported on the role of libraries in providing access to health information and resources (Bloss *et al.*, 2022; Ekere *et al.*, 2019; Jameson & Duhon, 2022; Knapp *et al.*, 2023; Okafor *et al.*, 2023; Swanberg *et al.*, 2022; Walker, 2021). The findings from the reviewed studies show that libraries play an important role in the provision of accurate and reliable health information to healthcare providers, educators, students and the general community. For example, Bloss *et al* (2022), Ekere *et al* (2019) and Knapp *et al* (2023) concur that

health libraries provide patrons with their desired health information resources which enable them to access health information they need for healthy decision making. Bloss *et al* (2022), Jameson and Duhon (2022), and Swanberg *et al* (2022) further hold that libraries promote health information literacy which enables individuals to access and use the most reliable health information resources.

Impacts of library services on healthcare research, education and training

Ten studies reported on the impacts of library services on healthcare research, education and training (Alpi, 2024; Bloss *et al*., 2022; Charbonneau & Vardell, 2022; Ekere *et al*., 2019; Jameson & Duhon, 2022; Kelham, 2014; Knuttel *et al*., 2020; Lenstra & Flaherty, 2020; Swanberg *et al*., 2022; Walker, 2021; Zager *et al*., 2016). Through the reviewed publications it was found that libraries and librarians contribute to health sector development by supporting healthcare research and facilitating education and training for healthcare providers as well as the public. Findings from other studies such as Bloss *et al* (2022), Charbonneau and Vardell (2022), Kelham (2014), Knuttel *et al* (2020) and Zager *et al* (2016) also confirm that libraries and health science librarians enhance health sector development through the provision of educational resources and training to the health workers and the community at large. Furthermore, based on the surveyed literature libraries support teaching and learning in health institutions through the provision of multimedia resources and creation of conducive environment for learning (Bloss *et al*., 2022; Ekere *et al*., 2019; Knapp *et al*., 2023). In addition, it was found that libraries provide healthcare research support to medical students and researchers through the provision of reference management tools, guidance in literature reviews and provision of access to research databases (Alpi, 2024; Charbonneau & Vardell., 2022; Ekere *et al*., 2019; Jameson & Duhon, 2022; Knuttel *et al*., 2020; Walker, 2021).

Effectiveness of library outreach programs in promoting public health

Analysis of the literature included in the study also reported about the effectiveness of library outreach programs in promoting public health. Studies revealed that library outreach programs promote public health through the provision of reliable health information resources to the community during outreach services (Alpi *et al*., 2024; Bloss *et al*., 2022; Jameson & Duhon, 2022; Kelham, 2014; Knapp *et al*., 2023; Lenstra & Flaherty, 2020). Library outreach programs also promote public health by enhancing health literacy which is done through the provision of health information resources and workshops (Bloss *et* al., 2022; Ekere *et al*., 2019; Jameson & Duhon, 2022; Lenstra & Flaherty, 2020;

Swanberg *et al.*, 2022; Zager *et al.*, 2016). Lastly, the reviewed studies revealed that libraries promote public health through community engagement. Through working with local organizations and communities, libraries enable community members to access health information services easily (Knapp *et* al., 2023; Jameson & Duhon, 2022; Kelham, 2014; Swanberg *et al.*, 2022; Zager *et al.*, 2016).

Collaboration of libraries with healthcare institutions to enhance health sector services

Analysis of the reviewed publications also revealed that libraries enhance health sector services through collaboration with healthcare institutions. Results from analysis of the publications included in the study show that libraries collaborate with healthcare institutions to improve the quality of healthcare services in different ways. For instance, libraries have been collaborating with healthcare institutions in enhancing health research through research data management, systematic reviews and meta-analyses and publication processes (Alpi *et al.*, 2024; Charbonneau & Vardell., 2022; Ekere *et al.*, 2019; Jameson & Duhon, 2022; Knuttel *et al.*, 2020; Lenstra & Flaherty, 2020; Walker, 2021). In collaboration with health departments, libraries enhance community health initiatives such as mental health support, health screening, vaccination drives and health education (Ekere *et al.*, 2019; Knapp *et al.*, 2023; Lenstra & Flaherty, 2020; Swanberg *et al.,* 2022; Zager *et al.,* 2016). Collaboration of libraries with health institutions supports clinical decisions as libraries facilitate the accessibility of up-to-date research, clinical guidelines and health-related databases such as PubMed and CINAHL (Ekere *et al.,* 2019; Jameson & Duhon, 2022; Knuttel *et al.,* 2020; Walker, 2021).

Discussion and Conclusion

This study based on an intensive literature review, to seek an understanding of the role of libraries in health sector development. After a thorough systematic process, 14 publications that focused on the contributions of libraries to health sector development were selected. Data analysis from the selected and reviewed studies provided a clear and comprehensive description of the library's contributions to health sector development. Generally, the findings of the study signify that libraries support healthcare research, education and training and promote public health.

Results obtained from analysis of the reviewed publications indicate that studies have been organized based on specific themes. The themes identified include the role of libraries in providing access to health information and resources, a

collaboration of libraries with healthcare institutions, effectiveness of library outreach programs in promoting public health and the impact of library services on healthcare research, education and training. Furthermore, the results indicate that most of the primary literature reviewed focused on specific themes, with only a few studies which focused on multiple themes. Notably, the analysis indicates that most studies focused on the impact of library services on healthcare research, education and training.

This study has highlighted the role of libraries in facilitating the development of the health sector as reported by various reviewed studies. Nonetheless, it has several limitations which create a loop for further research. First, the literature search of this systematic review involved studies published between 2014 and 2024. However, research on medical librarianship and the relationship of library and healthcare services have been carried out for decades. Thus, further research should consider literature published before 2014. This will shed more light on the role of libraries in health sector development. Second, although this study comprehensively and intensively examined the contributions of libraries to health sector development, it did not focus on barriers and challenges encountered by libraries and librarians in fostering health sector development. Thus, further research should address barriers and challenges of libraries in promoting health sector development. Last, this systematic review focused on health sector development alone. However, libraries and librarians have significant contributions to the development of almost all sectors. Therefore, further research is important to shed more light on the developmental roles of libraries in various sectors. Importantly however, results of this review provide researchers, librarians and health practitioners with the point of view on the current contributions of libraries to health sector development.

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Role of Community Libraries as Catalysts for Sustainable Development: A Case of Arusha Region, Tanzania

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Abstract
This study looked at how community libraries might promote sustainable development in Tanzania, particularly focusing Arusha Region. These libraries, which serve as vital information, education and social cohesion hubs, address crucial local issues such as low literacy rates and restricted access to formal education, particularly in disadvantaged rural communities. A cross-sectional study approach was used to collect data from 110 respondents, who included library personnel and community members. The data shows that library resources, financial assistance, and social equality all contribute considerably to sustainable development, although literacy rates have a more complicated link. Also, information access, community engagement and social inclusion have no significant influence on sustainable development. The study emphasizes the necessity of using community libraries as change agents to promote social, economic, and environmental sustainability at the grassroots level. The report recommends additional financing for community library infrastructures and emphasizes on social equality.

Keywords: *Community library, Sustainable development, social equality, Library resources.*

Introduction

In an era marked by rapid technological advancements and escalating global challenges, the role of libraries has expanded beyond their traditional function of housing books (Strover, 2019; Hirsh, 2022). Community libraries, in particular, have evolved into active information centres that promote social cohesion, economic empowerment and environmental awareness (Lee, 2024). Concurring with Lee, Okechukwu *et al* (2024) add that community libraries have developed into essential hubs that provide information, education and cultural interaction to underserved populations globally. As agents of change, these libraries are critical in navigating the complex landscape of sustainable development (Audunson *et al.*, 2019). The present study focused on understanding how community libraries in Arusha Region in Tanzania contribute towards sustainable development through their resources, services, financial support and efforts to attain social equality.

Originating in the late 19th and early 20th centuries, community libraries have expanded to offer programs such as reading initiatives and digital literacy training (Manzo, 2020). In developing regions like Africa, where literacy rates are low and access to formal education is limited, such libraries are often the first point of contact for educational resources and social cohesion efforts (Mojapelo, 2020: Nwagwu & Matobako, 2022). Through outreach programs in literacy, health education and civic engagement, these libraries, in collaboration with non-governmental organizations (NGOs) and governments, enhance their services and empower communities (Bangani, 2023).

Community libraries in Tanzania are crucial for fostering literacy and education, especially in rural areas where formal educational resources are limited (Bilonkwa, 2021). Tanzania has over 37 operational regional libraries, including the Tanzania National Library, with Arusha Regional Library being one of them and those owned by NGOs (Elbert *et al*., 2012). Other community libraries are the Akeri Free Library, which serves kids at Nkoanrua, Nkoarisambu and Akheri wards. This was developed by the Community Education Resource Foundation (CERFO). Another significant institution is the Durning-O'Halloran Community Library in Sinon Village. This was found in 2016 by Professor Richard Mshomba and his wife, Elaine. This library provides educational materials like books and Internet to kids of more than 15 schools, to help them succeed academically (Mshomba, 2022). Furthermore, the Viswani Public Library, situated on the outskirts of Arusha Region, was established in collaboration with Taiwanese students. These libraries provide essential resources like pamphlets, posters, periodicals, books, photos and newspapers. The most widely read materials include religious texts, newspapers, non-fiction works and adult literacy books (Malmgren, 2000). These libraries offer study space and access to over 2,000 books, encouraging local youngsters to read.

Supported by government initiatives and NGOs, these libraries aim to increase literacy rates by offering culturally relevant and locally significant materials that meet the unique needs of their communities (Bangani, 2023). Additionally, they host workshops on cultural events, health education and agricultural practices, contributing to cohesive and well-developed communities. Through these efforts, Tanzanian community libraries play a significant role in advancing social development goals, promoting social inclusion and fostering equity.

Sustainable development emphasizes the importance of inclusive growth that meets current needs without compromising the ability of future generations to meet their own (Hajian & Kashani, 2021). Within this context, community libraries emerge as institutions with significant potential to promote social, economic and environmental sustainability. In Arusha Region, community libraries function not only as reading centres but also as vital community development hubs. They provide access to knowledge, enhance literacy and encourage civic engagement, thereby contributing to the achievement of sustainable development objectives (Omona, 2020; Mansour, 2020).

This study investigated the transformational role of community libraries in fostering sustainable development in Tanzania. By examining their ability of acting as catalysts for positive change, the study explored how these libraries empower individuals and communities to address critical social, economic and environmental challenges (Salubi & Majavu, 2024). The study acknowledged the diversity of community library models, ranging from small, locally run venues to larger, professionally managed institutions (Lee, 2024). Each library operates within a unique context, shaped by local needs, resources and challenges, yet all play a crucial role in driving sustainable development and social equity at the grassroots level (Panda & Das, 2022).

Despite their potential as crucial hubs for education, social cohesion and economic empowerment, the role of community libraries in fostering sustainable development in Tanzania remains underexplored and underutilised. These libraries are instrumental in addressing the region's significant challenges such as low literacy rates, poverty and limited access to formal education, especially in rural areas (Bilonkwa, 2021; Manzo, 2020: Bangani, 2023). However, issues such as inadequate resources, insufficient financial support and limited outreach programs hinder their ability to fully contribute to social, economic and environmental sustainability (Hajian & Kashani, 2021). This study sought to bridge this gap by examining how community libraries in Tanzania can be better leveraged as catalyst of change, promoting literacy, social equality and sustainable development at the grassroots level.

Methodology

The study was conducted in the urban but comprised all community members using regional library and libraries owned by NGOs and other organizations in Arusha Region, Tanzania. The study was carried out at the selected communities

adjacent to these libraries since they are the ones that are served (Malugu, 2007). The target population of this study was residents of the Arusha Region who have access to community libraries. Cross-sectional research design was used because data was collected once and this design is used for descriptive statistics as well as determining the relationship between variables (Bailey, 1994: Kothari, 2004). However, data was collected through structured questionnaires and document analysis.

Random sampling technique was employed to select the sample for the study from the key stakeholders, including library staff, community members, local government officials and representatives of relevant NGOs in Arusha Region. This resulted in a population of 151 library stakeholders and a sample of the population involved in the study was obtained after deriving the following formula which resulted in 110 respondents. Lushakuzi *et al* (2017) report that the Yamane Formula is considered to save time and costs. It states as follows:

$$n = \frac{\Sigma N}{1 + \Sigma N (e)^2}$$

Where n= Sample size

ΣN = Total population size and *e*=level of precision which is 0.05 (5%).

This level of precision is an appropriate one since it is a stable level of precision and accuracy in survey study gives an appropriate sample size. Data was collected by using a questionnaire and the analysis of quantitative data was done with the help of Statistical Product and Service Solutions (SPSS) and Microsoft Excel.

Results and Findings

Description of demographic characteristics

Age of respondents

The age distribution of respondents demonstrates the broad involvement of many age groups in community libraries, with 20% of respondents under the age of 18, indicating early participation in educational activities. The largest group, 27.3%, were between the ages of 19 and 40, utilizing libraries for personal and professional development, while 18.2% were between the ages of 41 and 60, most likely engaging in lifelong learning and mentoring. Moreover, 34.5% of respondents were above the age of 60, indicating that community libraries are vital resources for people of all ages, encouraging lifelong learning and involvement in sustainable development projects.

Gender of respondents

The gender distribution of respondents suggests that men are more likely than women to participate in community library activities, with 59.1% and 40.9%, respectively. While males may be more active in leadership or in using resources for business and education, the large female involvement highlights the critical role women play in community engagement through libraries. This engagement is critical for fostering gender equality since libraries give access to information, education and opportunities that empower women and contribute to the community's overall sustainability. To address the somewhat lower female engagement, community libraries may assist in bridging gender inequalities by providing targeted programs that promote equal contributions from men and women to sustainable development.

Educational levels of respondents

Respondents' educational backgrounds suggest that 10.9% have only received elementary education, while 40% have finished basic secondary education, underlining the critical role community libraries play in complementing education for individuals with less formal training. These libraries give vital access to information and skills, supporting social fairness and empowering people to participate in sustainable development. This concurs with Mbwile's (2024) findings that show that literacy rates play a vital role in empowering society. Furthermore, with 49.1% of respondents having a college or university degree, community libraries promote advanced study, professional development and community service, bridging educational gaps and encouraging inclusive sustainable development in Arusha Region.

Table 1: Demographic Characteristics of the Respondents (n = 110)

Variable	Parameter	Freq.	%
Age	Below 18	22	20
	19 – 40	30	27.3
	41 – 60	20	18.2
	60+	38	34.5
Sex	Male	65	59.1
	Female	45	40.9
Educational level	Primary education	12	10.9
	Basic education (secondary)	44	40
	College/University	54	49.1

Source: Researcher Data (2024)

Regression analysis description

The regression study carried out to investigate the function of community libraries in improved livelihood for sustainable development yielded an R Square value of 0.264. This means that the model, which includes the predictors of Library Resources and Services (LRS), Information Access (IA), Community Engagement (CE), Budget and Financial Resources (BFR), Social Inclusion (SI), Literacy Rate (LR), and Social Equality (SE), accounts for approximately 26.4% of the variance in sustainable development (SD).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.514[a]	.264	.214	.356

a. Predictors: (Constant), SE, BFR, LR, IA, SI, LRS, CE

Source: Field Data (2024)

The Adjusted R Square value is 0.214, which considers the number of predictors in the model and gives a more realistic picture of the model's explanatory ability. This adjusted result shows that, after considering the number of predictors, 21.4% of the variance in sustainable development may be attributable to the cumulative effect of the independent.

The estimate's standard error is 0.356, which quantifies the average distance between the observed values and the regression line. A smaller standard error implies that the model's predictions are very close to the observed data.

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.935	.288		3.248	.002
LRS	.280	.093	.280	3.025	.003
BFR	.222	.071	.269	3.123	.002
LR	-.196	.096	-.185	-2.034	.045
SE	.216	.076	.256	2.837	.005

a. Dependent Variable: SD- improved livelihood.

Source: Field Data (2024)

Coefficients Interpretation and Discussion

The regression study attempts to better understand the influence of community library-related parameters on improving livelihood of people to ensure Sustainable Development (SD). The criteria considered are Library Resources and Services (LRS), Budget and Financial Resources (BFR), Literacy Rate (LR), and Social Equality (SE). The findings are interpreted as follows:

Constant

The constant term's unstandardized coefficient (B) is 0.935 with a standard error of 0.288, resulting in a t-value of 3.248 and a significant p-value of 0.002. This means that when all independent variables are set to zero, the baseline level of sustainable development is 0.935 units. This baseline serves as a reference point against which the impacts of the other factors are analyzed, emphasizing the inherent degree of sustainable development regardless of the predictors examined in the model.

Library resources and services

Library resources and services have a positive unstandardized coefficient of 0.280 and a standard error of 0.093. The t-value is 3.025 and the p-value is 0.003, implying statistical significance at the 1% level. The standardized coefficient (Beta) of 0.280 indicates that library resources and services have a significant and beneficial influence on sustainable development. This suggests that improving library resources and services makes a substantial contribution to fostering sustainable development. Improved access to varied and high-quality resources empowers communities via education and information distribution, promoting informed decision-making and supporting numerous aspects of sustainability, including economic growth, social fairness and environmental stewardship.

Mathiasson & Jochumsen (2022) support the findings that increasing libraries and library resources are expected to act proactively in relation to influencing equitable and sustainable development. This justifies that sufficient library resources have a direct impact on community development.

Budget and financial resources

Budget and financial resources have a positive unstandardized coefficient of 0.222 and a standard error of 0.071. The t-value is 3.123, and the p-value is 0.002, suggesting 1% significance. The standardized coefficient (Beta) is 0.269, indicating that budget and financial resources contribute significantly to

sustainable development. This emphasizes the need for proper financing and financial assistance in improving the ability of community libraries to provide excellent services and activities. Sufficient financial resources allow libraries to maintain and improve their infrastructure, purchase current content and execute activities that address many elements of sustainability, such as education, social inclusion and community resilience.

Financial resources are very important for any repository, like a library, to carry out their duties thoroughly. Budgeting and financial resources are crucial even if they are non-profit organizations since they are required to be equipped with the right and needed information resources that are costly (Linn, 2007). As seen in this study budgeting and financial resources have a positive influence on the effective functioning of community libraries, hence helping to attain sustainable development.

Literacy rate

Literacy rate has a negative unstandardized coefficient of -0.196 and a standard error of 0.096. The t-value is -2.034, and the p-value is 0.045, showing 5% significance. The standardized coefficient (Beta) is -0.185, indicating that greater literacy rates relate to lower levels of sustainable development in this model's environment. This unexpected conclusion might be attributed to a variety of variables, including measurement difficulties, the quality vs quantity of literacy, or increased literacy rates failing to translate directly into sustainable habits in the absence of supporting institutions and opportunities. It may also represent that as literacy improves, so does understanding and reporting of sustainability difficulties, resulting in a negative impact on perceived sustainable development. Further work is required to properly comprehend this link.

Shukla *et al* (2013) found that libraries are crucial for education, providing knowledge, civic sense, and intellectual recreation, enriching mental vision and promoting enlightenment, while also enhancing character and outlook on life. However, these findings indicate that low literacy rates in Tanzania hinder the effectiveness of community libraries as agents of change for sustainable development. Despite their potential to promote education and enlightenment, the limited literacy skills of the population reduce the impact these libraries can have on fostering informed and engaged communities.

Social Equality

Social equality has a positive unstandardized coefficient of 0.216 and a standard error of 0.076. The t-value is 2.837, with a p-value of 0.005, suggesting a 1% level of significance. Social equality is a substantial and influential predictor of sustainable development, as indicated by its standardized coefficient (Beta) of 0.256. This conclusion underscores the significance of achieving social equality through community libraries, which may function as inclusive venues that allow equal access to information and learning opportunities. Libraries that promote social equality help to reduce inequities, empower disadvantaged groups, and encourage cohesive and resilient communities, all of which are critical components of sustainable development.

Public libraries serve a critical role in ensuring social equality and long-term development in a stratified society. Community libraries address social gaps by offering critical resources and services to all people, regardless of socio-economic status. This fair access promotes lifelong learning, political involvement and economic empowerment, resulting in a more equitable and sustainable society (Gaffet & Espy, 2016: Kosmicki, 2019).

Conclusion and recommendations

Conclusion

Community libraries in Arusha Region contribute significantly to sustainable development by offering resources and services that improve literacy, social inclusion and economic empowerment. However, the study found that difficulties such as limited finances, poor literacy rates and uneven access to library services limit their ability to act as change agents. Despite these challenges, community libraries continue to play an important role in promoting social fairness and building knowledgeable, resilient communities that may contribute to long-term development at the grassroots level.

Recommendations

To optimize the influence of community libraries on Tanzania's sustainable development, stakeholders, including the government and non-governmental organizations, should boost financial support and invest in library infrastructures and resources. Furthermore, specialized literacy initiatives should be established to address low literacy rates, which restrict the efficacy of these libraries. Also, efforts should be made to guarantee that all community members, particularly

marginalized groups, have equitable access to library services, to promote social fairness and inclusive growth.

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